Cover photo: Professor Bruce Hansen works with Yanchang “Lily” Zhang ’17, Rachel Goldberg ’16, and Catherine Walsh ’16 to prepare test subject, Fiona Evans ’16, as they try to determine whether electroencephalography (EEG) captures the brain interpreting everyday experiences. See page 67 to read more about their summer research experience.  Photo by Andy Daddio.
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<td>Faculty Participants</td>
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List of Participants
DIVISION OF THE ARTS AND HUMANITIES (AHUM)

Department of Art and Art History

Name: Daniel Berry 2017 (Art and Art History; Peace and Conflict Studies)
Mentor: Padma Kaimal (Art and Art History)
Title: Kailasantha Temple Book Manuscript
Funding: AHUM Division

Name: Samantha Braver 2018 (Computer Science)
Mentor: Wenhua Shi (Art and Art History)
Title: Reload (Interactive Installation)
Funding: AHUM Division

Name: Michael DiGiorgio 2018 (Undeclared)
Mentor: Robert McVaugh (Art and Art History)
Title: Digital 3D Model of the Colgate Campus for Bicentennial Project
Funding: AHUM Division

Name: Mark Ma 2018 (Undeclared)
Mentor: Robert McVaugh (Art and Art History)
Title: Digital 3D Model of the Colgate Campus for Bicentennial Project
Funding: AHUM Division

Name: Virginia Moore 2017 (Educational Studies; Art and Art History)
Mentor: Penny Lane (Art and Art History)
Title: The Credits
Funding: AHUM Division

Name: Alex Rosenthal 2018 (Undeclared)
Mentor: Wenhua Shi (Art and Art History)
Title: Reload (Interactive Installation)
Funding: AHUM Division

Name: Derek Sherry 2018 (Physics)
Mentor: Robert McVaugh (Art and Art History)
Title: Digital 3D Model of the Colgate Campus for Bicentennial Project
Funding: AHUM Division

Name: Lauren Siano 2016 (Art and Art History)
Mentor: Robert McVaugh (Art and Art History)
Title: Colgate's Bicentennial: A History of West Hall
Funding: AHUM Division

Department of the Classics

Name: Erica Hiddink 2017 (Classics)
Mentor: Rebecca Ammerman (Classics)
Title: Nymphs of Magna Graecia
Funding: AHUM Division
Department of East Asian Languages and Literatures

Name: Li Jiang 2017 (History)
Mentor: John Crespi (Asian Studies; Chinese; East Asian Languages and Literatures)
Title: Scanlating Chinese Manhua Magazines
Funding: AHUM Division

Name: Elizabeth Johnson 2016 (Classics)
Mentor: Yukari Hirata (East Asian Languages and Literatures)
Title: Japanese Loanword Phonology: A Study in Transcription Methodology and Phonological Adaptation
Funding: AHUM Division

Name: Yizhou Mi 2017 (Mathematics)
Mentor: Jing Wang (East Asian Languages and Literatures)
Title: Five Centuries of Orientalism on China: An Anthology with a Critical Overview
Funding: AHUM Division

Name: Jiahao Shen 2017 (Japanese; Economics)
Mentor: Jing Wang (East Asian Languages and Literatures)
Title: Five Centuries of Orientalism on China: An Anthology with a Critical Overview
Funding: AHUM Division

Name: Yiyue Zhang 2017 (Psychology)
Mentor: Yukari Hirata (East Asian Languages and Literatures)
Title: A Training Method of Improving Mandarin Speakers’ Production of Japanese Stop Voicing Contrasts
Funding: AHUM Division

Department of English

Name: Sayed Ali “Ali” Kadhem 2017 (English)
Mentor: John Connor (English)
Title: Homosexuality in the Arab World: Critical Approaches
Funding: J. Curtiss Taylor ’54 Endowed Student Research Fund

Department of Religion

Name: Tra “Jade” Hoang 2017 (International Relations; Religion)
Mentor: Harvey Sindima (Religion)
Title: The Role of Buddhism in Sri Lanka’s Reconciliation Process
Funding: Lampert Institute for Civic and Global Affairs

Name: Emmett Potts 2015 (International Relations; Religion)
Mentor: Harvey Sindima (Religion)
Title: Muslim Diaspora Populations and Urban Renewal in Utica, NY
Funding: New York Six Liberal Arts Consortium

Name: Jennie Wilber—Hamilton College 2017 (Religion; Peace and Conflict Studies)
Mentor: Jenna Reinbold (Religion)
Title: Narrating an American Religion: The Hill Cumorah Pageant and the Story of Mormon Religious Freedom
Funding: New York Six Liberal Arts Consortium
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<td>Investigating antimicrobial properties of <em>Rhus typhina</em></td>
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<td>Mouse embryonic fibroblasts null for krüppel-like factor 4 exhibit impaired autophagy and an accumulation of dysfunctional mitochondria</td>
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<td>Paige Brooks</td>
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<td>Jason Meyers</td>
<td>Study of signaling in zebrafish lateral line development</td>
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<td>Dyani Davis</td>
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<td>Self-Authorship For Black Woman On College Campuses</td>
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<td>Identification of single-nucleotide polymorphisms associated with dog body size</td>
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<td>The Association Between Circadian Rhythms and Physical Activity</td>
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<td>James “Eddie” Watkins</td>
<td>The influence of increased CO2 on the western sword ferns and the future of the redwoods</td>
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<td>Andrew Kil</td>
<td>2016</td>
<td>Native American Studies; Molecular Biology</td>
<td>Mala Misra</td>
<td>Assessing the relationship between shape and function in sensory neurons of larval <em>Drosophila melanogaster</em></td>
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<td>Soo Bin Kwon</td>
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<td>Ahmet Ay</td>
<td>Assessment and Prediction of Human Circadian Rhythm</td>
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<td>Name:</td>
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Name: Elizabeth “Liz” Stratton 2016 (Molecular Biology)
Mentor: Engda Hagos (Biology)
Title: *Klf4 null MEFs exhibit increased Rho-mediated stress fiber formation associated with migration*
Funding: Michael J. Wolk ’60 Heart Foundation

Name: Nicholas “Nick” Whalen 2016 (Biology)
Mentor: Randy Fuller (Biology)
Title: *The impact of in-stream and whole drainage basin lime applications as a mitigation strategy for counteracting the effects of acid deposition on stream ecosystem structure and function*
Funding: NASC Division

Name: Margaret Wolsey 2017 (Biology)
Mentor: Engda Hagos (Biology)
Title: *Mouse embryonic fibroblasts null for krüppel-like factor 4 exhibit impaired autophagy and an accumulation of dysfunctional mitochondria*
Funding: Science and Math Initiative-SMI (NASC Division)

Name: Anastasiya Yandulskaya 2016 (Neuroscience)
Mentor: Jason Meyers (Biology)
Title: *Role of Notch signaling in regeneration of lateral line hair cells in zebrafish*
Funding: Michael J. Wolk ’60 Heart Foundation

Name: Junrui Ye 2016 (Mathematics; Computer Science)
Mentor: Ahmet Ay (Biology; Mathematics)
Title: *Reconstructing the Gene Regulatory Network Governing Traveling-Waves of the Vertebrate Segmentation Clock*
Funding: NASC Division

**Department of Chemistry**

Name: Drew Bader 2016 (Biochemistry)
Mentor: Roger Rowlett (Chemistry)
Title: *Structural Enzymology Studies of H.influenzae B-carbonic anhydrase*
Funding: NASC Division

Name: Nicholas “Nick” Baglieri 2018 (Undeclared)
Mentor: Codrina Popescu (Chemistry)
Title: *Expression and Isolation of Acetaldehyde Dehydrogenase for Biophysical Studies*
Funding: National Science Foundation (RUI)

Name: Tia Cervarich 2016 (Chemistry)
Mentor: Anthony Chianese (Chemistry)
Title: *Investigating Catalysts for the Hydrogenation of Polar Bonds*
Funding: NASC Division

Name: Katherine Colville 2016 (Biochemistry)
Mentor: Roger Rowlett (Chemistry)
Title: *Structural Enzymology Studies of H.influenzae B-carbonic anhydrase*
Funding: NASC Division

Name: Meghan DioGuardi 2018 (Undeclared)
Mentor: Anthony Chianese (Chemistry)
Title: *Iron Catalyst Synthesis and Catalytic Reactions*
Funding: National Science Foundation (RUI)
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<td>Geometry from electron diffraction radial distribution curve</td>
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<td>Investigation of a One-Flask Synthesis of an N-Confused Porphyrin Bearing Pentafluorophenyl Substituents</td>
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Department of Computer Science

Name: Abeneazer Chafamo 2017 (Computer Science)
Mentor: Michael Hay (Computer Science)
Title: Privacy Friendly Machine Learning: An Empirical Evaluation of Differentially Private Classifiers
Funding: National Science Foundation

Name: Michael Chavinda 2017 (Computer Science/Mathematics)
Mentor: Elodie Fourquet (Computer Science)
Title: Drawing: “The Elephant in the Coding Room”
Funding: NASC Division

Name: Wanqing “Cindy” Han 2017 (Mathematical Economics; Computer Science)
Mentor: Michael Hay (Computer Science)
Title: Privacy Friendly Machine Learning: An Empirical Evaluation of Differentially Private Classifiers
Funding: National Science Foundation

Name: Lillian “Lillie” Pentecost 2016 (Physics; Computer Science)
Mentor: John Stratton (Computer Science)
Title: Accelerating Dynamically Typed Languages with a Virtual Function Cache
Funding: Science and Math Initiative-SMI (NASC Division)

Name: Duy Tran 2017 (Computer Science; Political Science)
Mentor: Elodie Fourquet (Computer Science)
Title: Drawing: “The Elephant in the Coding Room”
Funding: Holdeen Endowment Fund

Department of Geology

Name: Hannah Bercovici 2017 (Geology)
Mentor: Karen Harpp (Geology; Peace and Conflict Studies)
Title: The Evolution of a Dying Magma Chamber
Funding: National Science Foundation

Name: Aurelia Casarrubias 2017 (Geology)
Mentor: Amy Leventer (Geology)
Title: Recent change in diatom populations recorded in sediments from the Larsen A Embayment, Antarctica
Funding: Norma Vergo Prize

Name: Taylor Dawson 2017 (Geology)
Mentor: William Peck (Geology)
Title: Carbon Isotopes in Emerald
Funding: NASC Division

Name: Meghan Duffy 2018 (Undeclared)
Mentor: Amy Leventer (Geology)
Title: Diatom Flux in Salmon Bay, Ross Sea, Antarctica and Diatom Variation at Larsen A Embayment, Antarctic Peninsula
Funding: Hackett-Rathmell 1968 Memorial Fund
Name: Sarah Katz 2016 (Geology)  
Mentor: William Peck (Geology)  
Title: *Metamorphism in Dutchess and Litchfield Counties, NY and CT*  
Funding: NASC Division

Name: Jackson Lucas 2017 (Geology)  
Mentor: Amy Leventer (Geology)  
Title: *Marine Sedimentary Records from Antarctica*  
Funding: National Science Foundation

Name: Jake Mahr 2017 (Geology)  
Mentor: Richard April (Geology)  
Title: *Mineral Collections Assistant*  
Funding: Geology Department

Name: Maggie McGuire 2016 (Geology)  
Mentor: Karen Harpp (Geology; Peace and Conflict Studies)  
Title: *Volcanic Evolution in the Galápagos: The Geochemistry and Petrology of Española Island*  
Funding: National Science Foundation

Name: Kaylie Patacca 2017 (Environmental Geography)  
Mentor: Amy Leventer (Geology)  
Title: *East Antarctic Paleoenvironments: Diatom Biostratigraphy*  
Funding: Norma Vergo Prize

Name: Ann “Annie” Preston 2016 (Geology; Environmental Studies)  
Mentor: Bruce Selleck (Geology)  
Title: *Stratigraphy & Sedimentology of the Ordovician Sequence in the Wells Outlier, Adirondack Park, NY*  
Funding: Doug Rankin ’53 Endowment-Appalachian Research

Name: John Quazza 2016 (Geology)  
Mentor: Karen Harpp (Geology; Peace and Conflict Studies)  
Title: *Investigation into the Insulating Properties of Tephra on Basaltic Lava*  
Funding: Doug Rankin ’53 Endowment-Geology Research

Name: Matthew Quinan 2017 (Geology)  
Mentor: William Peck (Geology)  
Title: *Geochronology of Grenville Province Minerals*  
Funding: Bob Linsley/James McLelland Fund

Name: Ashlyne Rando 2016 (Environmental Geology)  
Mentor(s): Richard April and Dianne “Di” Keller (Geology)  
Title: *Effects of Liming on Acidic Adirondack Soils*  
Funding: Doug Rankin ’53 Endowment-Geology Research

Name: Zachary “Zac” Sawin 2016 (Geology)  
Mentor: Karen Harpp (Geology; Peace and Conflict Studies)  
Title: *Exploration of Hazards Mitigation Methods for Basaltic Lava Flow*  
Funding: Doug Rankin ’53 Endowment-Geology Research

Name: Tiong Hua “Andy” Sia 2017 (Geology)  
Mentor(s): Richard April and Dianne “Di” Keller (Geology)  
Title: *Mineralogical Transformations in Adirondack Soils*  
Funding: Doug Rankin ’53 Endowment-Appalachian Research; Geology Department
Name: Rebecca Siladi 2016 (Geology)
Mentor: Bruce Selleck (Geology)
Title: *Stratigraphy & Sedimentology of the Ordovician Sequence in the Wells Outlier, Adirondack Park, NY*
Funding: NASC Division

Name: Victor Steffen 2016 (Natural Sciences)
Mentor: Constance Soja (Geology)
Title: *Digital Database of Linsley Fossil Collections and 3-D Printing of Colgate’s Dinosaur Egg*
Funding: Geology Discretionary Fund; Norma Vergo Prize

Name: Teymoor Tahbaz 2016 (Geology)
Mentor: Bruce Selleck (Geology)
Title: *Stratigraphy & Sedimentology of the Ordovician Sequence in the Wells Outlier, Adirondack Park, NY*
Funding: NASC Division

Name: Nathan Taylor 2017 (Geology; Music)
Mentor: Kelsey Winsor (Geology)
Title: *Greenland Ice Sheet Glacial History*
Funding: Hackett-Rathmell 1968 Memorial Fund

Name: Kevin Varga 2016 (Geology; Geography)
Mentor: Karen Harpp (Geology; Peace and Conflict Studies)
Title: *Understanding magmatic plumbing system dynamics at Fernandina Island, Galapagos*
Funding: National Science Foundation

Name: Allison Zengilowski 2017 (Psychology; Peace and Conflict Studies)
Mentor: Karen Harpp (Geology; Peace and Conflict Studies)
Title: *Analysis of Online Learning Experiment at Colgate University*
Funding: National Science Foundation

**Department of Mathematics**

Name: Julia Ceglowski 2016 (Mathematics; Biology)
Mentor: Evelyn Hart (Mathematics)
Title: *Endomorphisms of the Fundamental Group of the Double Torus*
Funding: NASC Division

Name: Ha Vu 2017 (Mathematics)
Mentor: Evelyn Hart (Mathematics)
Title: *Developing an algorithm to calculate the Nielsen number for the double torus*
Funding: NASC Division

**Department of Neuroscience**

Name: Jillian Belgrad 2017 (Neuroscience)
Mentor: Jun Yoshino (Neuroscience; Psychology)
Title: *The Effects of Antidepressants and a Serotonin Agonist on RAW 264.7 and Primary Cell Cultures*
Funding: NASC Division
Name: Rachel Goldberg 2016 (Neuroscience)  
Mentor: Bruce C. Hansen (Neuroscience; Psychology)  
Title: Decoding Image Category with Electroencephalography (EEG)  
Funding: NASC Division

Name: Abigail Lemons 2017 (Neuroscience)  
Mentor: Jun Yoshino (Neuroscience; Psychology)  
Title: The Effects of Antidepressants and a Serotonin Agonist on RAW 264.7 and Primary Cell Cultures  
Funding: NASC Division

Name: Catherine Walsh 2016 (Neuroscience)  
Mentor: Bruce C. Hansen (Neuroscience; Psychology)  
Title: Decoding Image Category with Electroencephalography (EEG)  
Funding: NASC Division

Name: Yanchang “Lily” Zhang 2017 (Neuroscience; Mathematical Economics)  
Mentor: Bruce C. Hansen (Neuroscience; Psychology)  
Title: Decoding Image Category with Electroencephalography (EEG)  
Funding: NASC Division

Department of Physics and Astronomy

Name: Anthony D’Addario 2018 (Undeclared)  
Mentor: Enrique “Kiko” Galvez (Physics and Astronomy)  
Title: Study of Nacre using Lights Polarization, where nacre is the iridescent surface of shells  
Funding: NASC Division

Name: Brian D’Auteuil 2016 (Physics)  
Mentor: Thomas Balonek (Physics and Astronomy)  
Title: Optical Variability of Blazar 3C454.3  
Funding: NASC Division

Name: Warren Dennis 2016 (History; Astronomy/Physics)  
Mentor: Jeffrey Bary (Physics and Astronomy)  
Title: Learning from NASA’s Past to Prepare for its Future  
Funding: Justus ’43 and Jayne Schlichting Student Research Fund; NASC Division

Name: Nicholas “Nick” Didio 2016 (Astronomy/Physics)  
Mentor: Thomas Balonek (Physics and Astronomy)  
Title: Optical Variability of the Blazar 3C 454.3  
Funding: Justus ’43 and Jayne Schlichting Student Research Fund

Name: Ishir Dutta 2017 (Physics)  
Mentor(s): Enrique “Kiko” Galvez and Joshua Jones (Physics and Astronomy)  
Title: Discriminatory Forces on Chiral Molecules  
Funding: Justus ’43 and Jayne Schlichting Student Research Fund

Name: Sean Foster 2016 (Physics)  
Mentor: Jonathan Levine (Physics and Astronomy; Pre-Engineering)  
Title: Mineral Identification Using a Prototype Spaceflight Mass Spectrometer  
Funding: NASC Division
<table>
<thead>
<tr>
<th>Name</th>
<th>Year</th>
<th>Major(s)</th>
<th>Mentor</th>
<th>Title</th>
<th>Funding</th>
</tr>
</thead>
<tbody>
<tr>
<td>Usman Ghani</td>
<td>2016</td>
<td>Physics; Biochemistry</td>
<td>Rebecca Metzler (Physics and Astronomy)</td>
<td>Correlating impurity concentration and crystal orientation to the fracture radius in Barnacle shells</td>
<td>NASC Division</td>
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<tr>
<td>Leah Jenks</td>
<td>2017</td>
<td>Astronomy/Physics</td>
<td>Thomas Balonek (Physics and Astronomy)</td>
<td>Optical Variability of the Blazar 454.3</td>
<td>NASC Division</td>
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<tr>
<td>Kidanemariam “Kidane”</td>
<td>Kebede 2016</td>
<td>(Physics)</td>
<td>Kenneth Segall (Physics and Astronomy)</td>
<td>Modeling of Neurons using Superconducting Josephson Junction</td>
<td>NASC Division</td>
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<tr>
<td>Katie Mason</td>
<td>2016</td>
<td>(Physics)</td>
<td>Kenneth Segall (Physics and Astronomy)</td>
<td>Cryogenic Measurements of Superconducting Josephson Networks</td>
<td>Justus ’43 and Jayne Schlichting Student Research Fund</td>
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<tr>
<td>Carolyn Morris</td>
<td>2017</td>
<td>Astronomy/Physics</td>
<td>Thomas Balonek (Physics and Astronomy)</td>
<td>Using Python for Astronomical Research</td>
<td>NASA / New York Space Grant; NASC Division</td>
</tr>
<tr>
<td>Jessica O'Malley</td>
<td>2017</td>
<td>(Physics)</td>
<td>Rebecca Metzler (Physics and Astronomy)</td>
<td>Exploring the correlation between atomic disorder and microhardness in barnacle exoskeletons</td>
<td>Justus ’43 and Jayne Schlichting Student Research Fund</td>
</tr>
<tr>
<td>Rebecca Rist</td>
<td>2016</td>
<td>(Physics)</td>
<td>Rebecca Metzler (Physics and Astronomy)</td>
<td>Composition and Structure of Oyster Cement Provides Unique Materials Properties</td>
<td>Justus ’43 and Jayne Schlichting Student Research Fund</td>
</tr>
<tr>
<td>Zachary “Zack” Weaver</td>
<td>2017</td>
<td>(Astronomy/Physics)</td>
<td>Thomas Balonek (Physics and Astronomy)</td>
<td>The Multi-Year Optical Variability of the Blazar 3C 454.3</td>
<td>NASC Division</td>
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<tr>
<td>Michael Williams</td>
<td>2018</td>
<td>Undeclared</td>
<td>Rebecca Metzler and Greggory “Todd” Springer (Physics and Astronomy)</td>
<td>Laboratory Design and Development</td>
<td>NASC Division</td>
</tr>
<tr>
<td>Name: Xuanyuan “Bill” Zhang 2017 (Physics)</td>
<td>Mentor: Kenneth Segall (Physics and Astronomy)</td>
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<tr>
<td><strong>Title:</strong> Using a damped pendulum to solve for non-linear differential equation</td>
<td><strong>Funding:</strong> NASC Division</td>
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**Department of Psychology**

<table>
<thead>
<tr>
<th>Name: Brandon Henry 2018 (Undeclared)</th>
<th>Mentor(s): Neil Albert and Douglas Johnson (Psychology)</th>
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<tr>
<td><strong>Title:</strong> Cognitive Resource Limits and Their Impacts on Recently Learned Information</td>
<td><strong>Funding:</strong> NASC Division</td>
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<tr>
<th>Name: Julia Kurtz 2016 (Psychology)</th>
<th>Mentor: Douglas Johnson (Psychology)</th>
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<tr>
<td><strong>Title:</strong> When “Incompetence” in Information Literacy is Relative: Findings and implications related to a common metacognitive error</td>
<td><strong>Funding:</strong> NASC Division</td>
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<th>Name: Chiara Martignetti 2017 (Psychology)</th>
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**DIVISION OF SOCIAL SCIENCES (SOSC)**

**Department of Anthropology**

<table>
<thead>
<tr>
<th>Name: Laura “Lorelai” Avram 2017 (Anthropology; Educational Studies)</th>
<th>Mentor: Mary Moran (Anthropology; Africana and Latin American Studies)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Title:</strong> The nationwide 2014-2015 Mexican social movement for justice</td>
<td><strong>Funding:</strong> SOSC Division</td>
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<tr>
<th>Name: Angela Jang 2017 (Sociology)</th>
<th>Mentor: Elana Shever (Anthropology)</th>
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<tr>
<td><strong>Title:</strong> Prehistoric Traces and Popular Icons: The Cultural Politics of Dinosaurs in the United States</td>
<td><strong>Funding:</strong> SOSC Division</td>
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<tr>
<th>Name: Bobae Kang 2016 (Sociology and Anthropology)</th>
<th>Mentor: Nancy Ries (Anthropology; Peace and Conflict Studies)</th>
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<td><strong>Title:</strong> Schools in Sin City: The Las Vegas Education Machine and Its Operations in the Casino-Oriented Environment</td>
<td><strong>Funding:</strong> Lampert Institute for Civic and Global Affairs</td>
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<th>Name: Kristen Kennefick 2016 (Anthropology)</th>
<th>Mentor: Elana Shever (Anthropology)</th>
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**Department of Economics**

<table>
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<tr>
<th>Name: Adib Chowdhury 2017 (Economics; Mathematics)</th>
<th>Mentor: Richard Higgins (Economics)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Title:</strong> The impact of faculty unionization on faculty salaries: Case study of the University of Oregon</td>
<td><strong>Funding:</strong> SOSC Division</td>
</tr>
</tbody>
</table>
Name:  Ian Ettinger 2017 (Economics)  
Mentor: Carolina Castilla (Economics)  
Title: *On Sales and Tax Holidays: Behavioral Evidence from a Natural Experiment in Massachusetts*  
Funding: SOSC Division

Name:  Weilin “Emily” Gu 2017 (Economics)  
Mentor: Chad Sparber (Economics)  
Title: *Skill Response to Immigrants within Skill Cells*  
Funding: New York Six Liberal Arts Consortium

Name:  Quinn Steigleder 2017 (Mathematical Economics)  
Mentor: Chad Sparber (Economics)  
Title: *Upstate-Global Collective Summer Research Program*  
Funding: New York Six Liberal Arts Consortium

**Department of Educational Studies**

Name:  Abril Cardenes 2017 (Sociology)  
Mentor: Melissa Kagle (Educational Studies)  
Title: *Paranoia at the University*  
Funding: SOSC Division

Name:  Rachel Drucker 2017 (Educational Studies)  
Mentor: Mark Stern (Educational Studies)  
Title: *Notes on a Feminist Reading of Education Policy*  
Funding: SOSC Division

Name:  Caroline Kielar 2017 (Psychology; Educational Studies)  
Mentor: Mark Stern (Educational Studies)  
Title: *Animal Assisted Therapy on College Campuses*  
Funding: SOSC Division

**Department of Geography**

Name:  Katrina Bennett 2016 (Neuroscience)  
Mentor: Ellen Kraly (Geography; Environmental Studies)  
Title: *Pediatric HIV Disclosure in Kenya*  
Funding: Lampert Institute for Civic and Global Affairs

Name:  Julia Feikens 2018 (Undeclared)  
Mentor: Daisaku Yamamoto (Geography)  
Title: *Coping with Nuclear Decommissioning Shocks in Local Communities in the U.S.: Case studies of Haddam, Connecticut and Wiscasset, Maine*  
Funding: SOSC Division

Name:  Melissa Haller 2016 (Geography; Economics)  
Mentor: Daisaku Yamamoto (Geography)  
Title: *Coping with Nuclear Decommissioning Shocks in Local Communities in the U.S.: Case studies of Haddam, Connecticut and Wiscasset, Maine*  
Funding: SOSC Division

Name:  Emily Luba 2016 (Geography; Peace and Conflict Studies)  
Mentor: Ellen Kraly (Geography; Environmental Studies)  
Title: *A Community-based Approach to Trauma Healing and Advocacy in Nakivale Refugee Settlement, Uganda*  
Funding: Lampert Institute for Civic and Global Affairs
Name: Lindsay McCulloch 2016 (Environmental Biology; Geography)  
Mentor: Michael Loranty (Geography)  
Title: Vegetation Impacts on Permafrost  
Funding: SOSC Division

Name: Alaina Norzagaray 2018 (Geography)  
Mentor: Michael Loranty (Geography)  
Title: Vegetation and ecosystem impacts on permafrost vulnerability  
Funding: SOSC Division

Name: Alexander “Alex” Pustelnyk 2017 (Philosophy; Geography)  
Mentor: Maureen Hayes-Mitchell (Geography)  
Title: Politics for the People: Political Legitimacy in Peru’s Informal Housing Settlements  
Funding: Lampert Institute for Civic and Global Affairs

Name: Karl Louis Uy 2016 (Environmental Biology)  
Mentor: Michael Loranty (Geography)  
Title: Vegetation Impacts on Permafrost (VIPER)  
Funding: SOSC Division

Department of History

Name: Anne “Maddy” Canning 2018 (Undeclared)  
Mentor: Graham Hodges (History)  
Title: Self-Emancipation in American History: Beyond the Underground Railroad  
Funding: SOSC Division

Name: John “Jack” McKay 2017 (History)  
Mentor: Graham Hodges (History)  
Title: Self-Emancipation in American History: Beyond the Underground Railroad  
Funding: SOSC Division

Name: Jane Trask 2016 (History)  
Mentor: Jason Petrulis (History)  
Title: Envisioning the Colgate Bicentennial: West Hall  
Funding: SOSC Division

Name: Emily Wong 2018 (Undeclared)  
Mentor: Jason Petrulis (History)  
Title: The Interclass Rivalry at Colgate University  
Funding: SOSC Division

Department of Political Science

Name: Bryan Dewan 2017 (Political Science; Computer Science)  
Mentor: Barry Shain (Political Science)  
Title: Revolutionary-era American Pamphlet Literature in Context: a Documentary History 1764-1776  
Funding: SOSC Division

Name: Hongyi “Steven” Huang 2017 (Mathematical Economics; International Relations)  
Mentor: Edward “Ed” Fogarty (Political Science)  
Funding: Research Council
Name: John “Jack” McCaslin 2016 (International Relations)  
Mentor: Edward “Ed” Fogarty (Political Science)  
Funding: Research Council

Name: Anna Proios 2017 (Religion)  
Mentor: Bruce Rutherford (Political Science; Middle Eastern Studies and Islamic Civilization)  
Title: *UNRWA and Palestinian Prospects for Peace*. The goal of this project is to provide an overview of the purpose of the United Nations Relief and Works Agency for Palestinian Refugees in the Near East (UNRWA) as an institution today and in the process  
Funding: SOSC Division

Name: Julia Schaevitz 2016 (History)  
Mentor: Barry Shain (Political Science)  
Title: *Revolutionary-era American Pamphlet Literature in Context: a Documentary History 1764-1776*  
Funding: SOSC Division

Name: Sara Sirota 2016 (Political Science)  
Mentor: Valerie Morkevicius (Political Science)  
Title: *Interveners and Perpetrators: Ethnic Cleansing During the 1992-1995 Bosnian War*  
Funding: Lampert Institute for Civic and Global Affairs

Name: Maria Vorobyeva 2018 (Undeclared)  
Mentor: Daniel “Dan” Epstein (Political Science)  
Title: *Origins of Political Power in Russia*  
Funding: Research Council

**Department of Sociology**

Name: Cody Hawkins 2016 (Sociology)  
Mentor: Alicia Simmons (Sociology)  
Title: *Print Media Framing of the Killings of Unarmed Blacks by Whites*  
Funding: SOSC Division

Name: Kellyann Hayes 2016 (English; Sociology)  
Mentor: Alicia Simmons (Sociology)  
Title: *Print Media Framing of the Killings of Unarmed Blacks by Whites*  
Funding: SOSC Division

**DIVISION OF UNIVERSITY STUDIES (UNST)**

**Department of Africana and Latin American Studies**

Name: Madison Paulk 2016 (Political Science; Africana and Latin American Studies)  
Mentor: Mary Moran (Anthropology; Africana and Latin American Studies)  
Title: *United Nations High Commissioner for Refugees, ‘Convention and Protocol Relating to the Status of Refugees,’ 1951*  
Funding: Lampert Institute for Civic and Global Affairs

**Department of Asian Studies**

Name: Jason Alexander 2017 (History; Japanese)  
Mentor: David Robinson (Asian Studies; History)  
Title: *Glorification of Edo Popular Urban Culture via Derisive Literature*  
Funding: UNST Division
Name: Hailey Savage 2016 (Asian Studies)
Mentor: John Crespi (Asian Studies; Chinese; East Asian Languages and Literatures)
Title: *China’s Lost Girls...Found!*
Funding: Lampert Institute for Civic and Global Affairs

Department of Environmental Studies

Name: Michael James 2017 (Environmental Studies; Biology)
Mentor: Catherine Cardelús (Biology; Environmental Studies)
Funding: UNST Division

Name: Roxanne Maduro 2017 (Environmental Studies)
Mentor: Catherine Cardelús (Biology; Environmental Studies)
Funding: UNST Division

Department of Peace and Conflict Studies

Name: Lucas “Luke” Musetti 2017 (Peace and Conflict Studies)
Mentor(s): Jacob Mundy (Peace and Conflict Studies) and Nancy Ries (ANTH; Peace and Conflict Studies)
Title: *Domestic Disturbance: An Evaluation of Police Militarization in America*
Funding: UNST Division

Department of Writing and Rhetoric

Name: Zachary Abt 2016 (Classics; Computer Science)
Mentor: Margaret “Meg” Worley (Writing and Rhetoric)
Title: *Encoding the Ormulum*
Funding: UNST Division

LAMPERT INSTITUTE FOR CIVIC AND GLOBAL AFFAIRS

Name: Katrina Bennett 2016 (Neuroscience)
Mentor: Ellen Kraly (Geography; Environmental Studies)
Title: *Pediatric HIV Disclosure in Kenya*
Funding: Lampert Institute for Civic and Global Affairs

Name: Tra “Jade” Hoang 2017 (International Relations; Religion)
Mentor: Harvey Sindima (Religion)
Title: *The Role of Buddhism in Sri Lanka’s Reconciliation Process*
Funding: Lampert Institute for Civic and Global Affairs

Name: Bobae Kang 2016 (Sociology and Anthropology)
Mentor: Nancy Ries (Anthropology; Peace and Conflict Studies)
Title: *Schools in Sin City: The Las Vegas Education Machine and Its Operations in the Casino-Oriented Environment*
Funding: Lampert Institute for Civic and Global Affairs

Name: Emily Luba 2016 (Geography; Peace and Conflict Studies)
Mentor: Ellen Kraly (Geography; Environmental Studies)
Title: *A Community-based Approach to Trauma Healing and Advocacy in Nakivale Refugee Settlement, Uganda*
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<th>Name</th>
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<tbody>
<tr>
<td>Alexander “Alex” Pustelnyk</td>
<td>2017</td>
<td>Philosophy; Geography</td>
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<td>2016</td>
<td>Asian Studies</td>
<td>John Crespi (Asian Studies; Chinese; East Asian Languages and Literatures)</td>
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<td>2017</td>
<td>Economics</td>
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<td>New York Six Liberal Arts Consortium</td>
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<tr>
<td>Emmett Potts</td>
<td>2015</td>
<td>International Relations; Religion</td>
<td>Harvey Sindima (Religion)</td>
<td>Muslim Diaspora Populations and Urban Renewal in Utica, NY</td>
<td>New York Six Liberal Arts Consortium</td>
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<tr>
<td>Quinn Steigleder</td>
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<td>Mathematical Economics</td>
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**NEW YORK SIX LIBERAL ARTS CONSORTIUM**

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<td>Wellin “Emily” Gu</td>
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<td>Upstate-Global Collective Summer Research Program</td>
<td>New York Six Liberal Arts Consortium</td>
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**RESEARCH COUNCIL**

<table>
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<tr>
<th>Name</th>
<th>Year</th>
<th>Major(s)</th>
<th>Mentors</th>
<th>Title</th>
<th>Funding</th>
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<tr>
<td>Hongyi “Steven” Huang</td>
<td>2017</td>
<td>Mathematical Economics; International Relations</td>
<td>Edward “Ed” Fogarty (Political Science)</td>
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<td>John “Jack” McCaslin</td>
<td>2016</td>
<td>International Relations</td>
<td>Edward “Ed” Fogarty (Political Science)</td>
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<td>Research Council</td>
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Name: Maria Vorobyeva 2018 (Undeclared)
Mentor: Daniel “Dan” Epstein (Political Science)
Title: Origins of Political Power in Russia
Funding: Research Council

UPSTATE INSTITUTE

Name: Kayleigh Bhangdia 2016 (Geography; Environmental Studies)
Mentor: Julie Dudrick (Upstate Institute)
Title: Field School Fellow with Madison County Health Department
Funding: Upstate Institute

Name: Michelle Cao 2016 (Economics)
Mentor: Julie Dudrick (Upstate Institute)
Title: Field School Fellow with Cornell Cooperative Extension-Madison County
Funding: Upstate Institute

Name: Prosper Chitongo 2017 (Mathematics)
Mentor: Julie Dudrick (Upstate Institute)
Title: Field School Fellowship with Fiver Children's Foundation
Funding: Upstate Institute

Name: Jennifer “Jenn” Dias 2016 (Biology; Spanish)
Mentor: Julie Dudrick (Upstate Institute)
Title: Field School Fellow with the Chenango United Way
Funding: Upstate Institute

Name: Valeria Felix 2018 (Sociology)
Mentor: Julie Dudrick (Upstate Institute)
Title: Field School Fellow with the National Abolition Hall of Fame and Museum
Funding: Upstate Institute

Name: Olivia Gamble 2015 (Economics; Spanish)
Mentor: Julie Dudrick (Upstate Institute)
Title: Field School Fellow with Madison County Department of Health
Funding: Upstate Institute

Name: Jerod Gibson-Faber 2016 (History)
Mentor: Julie Dudrick (Upstate Institute)
Title: Field School Fellow with Oneida County Historical Society
Funding: Upstate Institute

Name: Mallory Hart 2016 (Environmental Economics)
Mentor: Julie Dudrick (Upstate Institute)
Title: Field School Fellow with Friends of Rogers Environmental Education Center
Funding: Upstate Institute

Name: Henry Marshall 2017 (History)
Mentor: Julie Dudrick (Upstate Institute)
Title: Field School Fellow with Hamilton Town Clerk and Madison County Historian
Funding: Upstate Institute
Name: Anna McHugh 2017 (Environmental Biology)  
Mentor: Julie Dudrick (Upstate Institute)  
Title: Field School Fellow with Chenango Canal Association and Southern Madison Heritage Trust  
Funding: Upstate Institute

Name: Chi Nguyen 2018 (Undeclared)  
Mentor: Julie Dudrick (Upstate Institute)  
Title: Field School Fellow with the Chenango United Way  
Funding: Upstate Institute

Name: Julia “Katelyn” Parker 2016 (Environmental Studies; Geography)  
Mentor: Julie Dudrick (Upstate Institute)  
Title: Field School Fellow with the Lake Moraine Association  
Funding: Upstate Institute

Name: Jessica Pearce 2018 (Educational Studies)  
Mentor: Julie Dudrick (Upstate Institute)  
Title: Field School Fellow with the National Abolition Hall of Fame and Museum  
Funding: Upstate Institute

Name: Kendra Peeples 2016 (International Relations)  
Mentor: Julie Dudrick (Upstate Institute)  
Title: Field School Fellow with Kriemhild Dairy Farms  
Funding: Upstate Institute

Name: Kristine “Kris” Pfister 2017 (Art and Art History)  
Mentor: Julie Dudrick (Upstate Institute)  
Title: Field School Fellow with The Sam and Adele Golden Foundation for the Arts/The Horned Dorset Colony  
Funding: Upstate Institute

Name: Catherine Quirion 2017 (Neuroscience)  
Mentor: Julie Dudrick (Upstate Institute)  
Title: Field School Fellow with Pathfinder Village  
Funding: Upstate Institute

Name: Leda Rosenthal 2018 (Undeclared)  
Mentor: Julie Dudrick (Upstate Institute)  
Title: Field School Fellow at Cornell Cooperative Extension  
Funding: Upstate Institute

Name: Nihar Shah 2016 (English)  
Mentor: Julie Dudrick (Upstate Institute)  
Title: Field School Fellowship with Sculpture Space  
Funding: Upstate Institute

Name: Jessica Sullivan 2016 (Peace and Conflict Studies; Middle Eastern Studies and Islamic Civilization)  
Mentor: Julie Dudrick (Upstate Institute)  
Title: Field School Fellow with the Mohawk Valley Resource Center for Refugees  
Funding: Upstate Institute

Name: Shunong Sun 2018 (Undeclared)  
Mentor: Julie Dudrick (Upstate Institute)  
Title: Field School Fellow with the Community Action Partnership and Upstate Institute  
Funding: Upstate Institute
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<tr>
<th>Name</th>
<th>On Tim “OT” Tang 2017 (Political Science; International Relations)</th>
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<td>Mentor</td>
<td>Julie Dudrick (Upstate Institute)</td>
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<td>Title</td>
<td>Field School Fellow with Legal Aid of Mid-New York</td>
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<td>Name</td>
<td>Phyo Thant 2016 (Mathematical Economics)</td>
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<td>Title</td>
<td>Field School Fellow with Madison County Cultural &amp; Heritage Tourism Committee</td>
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<td>Name</td>
<td>Sydney Thompson 2017 (History; Environmental Studies)</td>
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<td>Mentor</td>
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<td>Title</td>
<td>Field School Fellow with The Impact Project</td>
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<td>Name</td>
<td>Cynthia Vele 2017 (Spanish)</td>
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<td>Mentor</td>
<td>Julie Dudrick (Upstate Institute)</td>
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<td>Title</td>
<td>Field School Fellow with Young Scholars Liberty Partnership Program at Utica College</td>
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<td>Funding</td>
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Research Summaries
Encoding the Ormulum is part of a larger project, the Archive of Early Middle English, worked on by Professor Worley and others under the NEH Scholarly Editions & Translations Grant. Their goal is the creation of digital critical editions for the texts that fall into this two hundred year period. For the Ormulum, the digital edition was formed from the original manuscript of the text aided by the last transcription of the piece done in 1878.

The manuscript of the Ormulum that rests in the Bodleian Library in Oxford is a mess. Blacked-out lines and marginal insertions cover the pages while whole sections of this biblical commentary can be found on separate scraps of parchment with the jumps indicated only by some small mark in the middle of the text found again on the scrap. The author, a monk named Orm, wastes no space. He uses a generous amount of abbreviations both when writing in his specific dialect of Middle English and especially in the few instances of Latin when he quotes the Bible. These orthographic tendencies create a text that does not lend itself well to simple transcription and so leads us to TEI, the text encoding initiative.

The purpose of TEI is to develop a standard for digitally representing manuscripts, such as our sole remaining copy of the Ormulum at Oxford, and printed materials. TEI uses their own version of the coding language XML, a cousin to HTML, to mark everything on the manuscript from blemishes and rips to differentiating the script hands of multiple writers. With TEI we were able to capture much of what Holt and White, the last transcribers, were not.

In addition to more accurate representation, the encoding allows for the marking of notable elements allowing any interested scholars to more easily search the texts. The spellings of things such as the names of people or places were not standardized during this time so knowing what to look for can be a challenge. By tagging a name with a unique identifier, it can be found easily even being spelled however Orm or another author may spell it. Other potential topics of research like unusual syntactic constructions or style choices can also be marked.

While some of Orm’s idiosyncrasies posed new questions, they were resolved without much trouble. The primary issue is simply that it takes time. At the end of summer, three-quarters of the manuscript were encoded and so work on the project must continue.

Research Fellow: Jason Alexander (2017)  
Concentration(s): History; Japanese  
Faculty Mentor: David Robinson  
Department(s): Asian Studies; History  
Title of Project: Glorification of Edo Popular Urban Culture via Derisive Literature  
Project Summary:  
My work investigated the intersection between literary publications and the cultures of different communities creating them. In particular, I focused on 18th century Edo, the capital of Japan during the Tokugawa period, from which a large quantity of humorous mass-published commercial fiction (gesaku) arose. Using anthologies and miscellaneous translations of stories, I read a broad range of stories published from 1750 to 1820. I have included more than twenty such translated works of fiction in my survey, with supplemental diaries, travel accounts, and intellectual writings from the time period. Additionally, I travelled to Cornell University to investigate their Rare and Manuscript Collections, finding very interesting original copies of the illustrated fiction (as seen at right and below, Jippensha Ikku’s Purple Asakusa Souvenirs). Since many stories are illustrated, there are also symbolic and humorous composition techniques that impact the story’s tone. Through textual and visual methods, these books present their author’s perceptions of other Japanese spaces and communities, classifying and judging different behaviors.  
The widespread peace of the Tokugawa period facilitated Edo’s population growth to one million citizens and accompanying cultural expansion. The key items of interest in the books are portrayals of urban and rural cultural differences, including visual and textual representation of different character types and different qualities of narrative presentation. Essentially, gesaku books generate an ideal of exceptionalism or superiority in Edo, based upon the behavior of the city’s commoners. Authors present a variety of character types, who either succeed or fail at demonstrating proper knowledge of Edo customs. Samurai, scholars, and peasants all come from the countryside or smaller cities such as Kyoto and Osaka. Their ignorance serves as the subject of many jokes. Mocked customs are obliviousness to fashion trends, lack of money, ignorance of entertainment styles, a different dialect, and arrogance or fraud.  
This research takes into account a variety of different facets including cartographic processes, morals and ideology, social class structure, and publishing. All of these affected the lives of Japanese in different ways depending on their region, living circumstances, and occupation. This context is significant for realizing the type of impact literature would have on different cities and regions outside of the literature’s target demographic – for example, farmers had little to do with frivolous texts. The literary perspectives are a form of education, and even affected Edo’s children’s books and school curriculums.  
As Edo’s commoner population created literature that reflected their derisive attitudes towards other regions’ customs, they drifted away from the ideal unified structure of the Tokugawa polity. Gesaku books subverted moralistic and class-based justifications for social conduct, teaching commoners how to view the rest of Japan and achieve a better reputation in Edo’s spaces of opportunity.  
Source of Support:  
☐ AHUM Div.  ☐ NASC Div.  ☐ SOSC Div.  ☒ UNST Div.  
☐ Other (specify):
Research Fellow(s): Eric Alvarado (2018)  
Corrina Moncada (2018)  
Faculty Mentor: Frank Frey  
Department(s): Biology; Environmental Studies  
Title of Project: Investigating antimicrobial properties of *Rhus typhina*  
Project Summary:

Our research this summer sought to extend previous work done by Kelly French ('15) and Mae Staples ('15) in the Frey lab. Utilizing a series of disc diffusion assays and serial dilution assays to determine minimum inhibitory concentrations of whole extracts, they confirmed that the leaves, berries, and inner bark of *Rhus typhina* (staghorn sumac) showed anti-bacterial properties against a number bacterial species. The overall goal of our research was to first replicate the results of French and Staples, and then empirically determine a protocol for separating whole extract material into various fractions containing molecules with similar properties. These fractions could then be tested against bacteria to narrow the chemical class of molecules responsible for the antibacterial properties, and provide material for subsequent chemical analyses to identify the bioactive compounds. This research could provide leads for new compounds that might be effective in combating bacterial infections, especially *Staphylococcus aureus*, for which sumac extracts are very effective against.

We started by collecting fresh *R. typhina* material to prepare new extractions (Figure 1a) and then used disc diffusion assays to confirm inhibitory effects (Figure 1b). After an extensive review of the literature, we chose to investigate a set of alternative solvent systems to separate out compounds via column chromatography. Specifically, we tested: chloroform-methanol (80:0.5), chloroform-acetone (5:4), chloroform-ethyl acetate-formic acid (5:4:1), ethyl acetate-methanol-water (10:1:35:1) 1,2. In addition to these starting concentrations, we varied altered the ratio of each to vary the polarity within each solvent system to find the optimal concentrations that separated whole extract. We used thin layer chromatography (TLC) under ultraviolet light to visualize the efficacy of each solvent system in separating whole extract material. Ethyl acetate-methanol-water solvent systems appeared most promising in generating separation; therefore, the modification of the net polarity of the solvent combination to determine optimal separation of whole leaf extract found that ethyl acetate-methanol-water (10:1:0.25) was the best (Figure 4). We then used small-scale flash chromatography with the solvent ethyl acetate-methanol-water (10:1:0.25), to collect 18 fractions of about 150μL each. These fractions were then assessed alongside whole extract in TLC plates to examine the separation of compounds from whole extracts and further refine the protocol before testing in a large-scale column (Figure 5).

Our refinement of a successful protocol to separate out compounds using small-scale chromatography allowed us to begin work on scaling up the chromatography to a 20cm x 2cm column with a 100mL reservoir. We began implementing our new protocol and also piloting how best to evaporate solvent from the collected fractions and resuspend them in a water-based solvent for use on the disc diffusion assays. There is a lot to follow up on from the work this summer, and we are looking forward to continuing our work on this project.

**Figure 1.** Leaf extraction procedure (a). 300mg of dried and ground sumac leaf refined in 100mL of water at 90C for two hours, left to sit overnight, and then centrifuged at 3,000g for 20 minutes to collect supernatant. Disc diffusion assay (b). Sample replicate plate showing S. aureus grown on LB media in the presence of 10μL water (1, 0.5mg/ml ampicillin (2), and sumac leaf extract (3).  

**Figure 4.** Sample TLC plates showing whole leaf extract of *R. typhina* in ethyl acetate-methanol-water combinations of varying polarity. Optimal separation at 10:1:0.25.  

**Figure 5.** Sample TLC plates showing the 18 different fractions collected from the small scale flash chromatography. It appears we can separate out the different bands in the whole extract using our chromatography system of silica gel and 10:1:0.25 ethyl acetate-methanol-water.

Sources:


Source of Support:  
☐ AHUM Div.  ☑ NASC Div.  ☐ SOSC Div.  ☐ UNST Div.  
☑ Other (specify): Science and Math Initiative-SMI (NASC Division)
Entamoeba histolytica contains an alcohol dehydrogenase enzyme, generically known as ADHE, which has 2 activities: the N terminus of this enzyme provides the sequence for ALDH (so-called acetaldehyde dehydrogenase) and the C terminus provides the sequence for the ADH (alcohol dehydrogenase) function. Previous studies have revealed iron-dependence for both activities, but there have been no studies to determine the structure of the iron centers. Determining the structure of ALDH will provide insight into how it functions and can explain the results of mutations in past studies. In our research group, we have attempted to isolate the protein for x-ray crystallography and Mossbauer spectroscopy studies.

E. Coli cells containing the pRP1B plasmid (for the ALDH domain) were grown according to procedures similar to other over-expression systems. The gene construct expresses a protein with a histidine-rich tail, such that a nickel affinity column can be used for protein purification. We have experimented with expression and purification protocols that have been used only once successfully. Thus, the cell-free extract was loaded onto a nickel affinity column on a Akta Prime fast-protein liquid chromatography system. Fractions were collected and monitored by absorbance detection. We ran activity assays based on NADH oxidation in the reaction between ALDH and acetyl-CoA as substrate. Significant activity was found in the crude extract.

SDS-PAGE was used to test the presence of the protein in crude cell-free extracts and fractions. While we were not able to isolate the ALDH in fractions, the crude extract shows a band at 50 kDa. This band and the enzymatic activity found in the crude extract, indicate that we may have ALDH enzyme in our cells, but the nickel affinity column did not purify the enzyme, rather ALDH may have been lost in the column wash which was not collected. In order to ascertain that our cells contain the desired recombinant ALDH enzyme agarose gel electrophoresis will be run to ensure the correct plasmid is still in the bacteria. In addition, in our future enzyme preparations we will collect and assay all the eluates from the nickel column.

Legend for the figure below, in order from 1 to 8: (1, 8) Molecular Weight Standard, (2, 7) Pellet (3, 6) His Trap, (4, 5) Cell Free Extract, and then in reverse order from there.
Title of Project: Mouse embryonic fibroblasts null for krüppel-like factor 4 exhibit impaired autophagy and an accumulation of dysfunctional mitochondria

Project Summary:

Autophagy is a major cellular process by which cytoplasmic components such as damaged organelles are recycled. Certain cellular stresses such as nutrient depletion and oxidative stress are known to robustly induce autophagy.

In particular, the degradation of dysfunctional mitochondrial components is termed mitophagy. This process is able to improve mitochondrial DNA (mtDNA) quality in heteroplasmic mtDNA disease, in which mutant mtDNA co-exists with normal mtDNA.¹ In addition, dysfunctional mitochondria may play a role in the production of reactive oxygen species (ROS) in the cells. This production of reactive oxygen species causes damages in the DNA of the cells which, in turn, can possibly causes the cells to be cancerous.

Krüppel-like factor 4 (KLF4) is a zinc-finger transcription factor activated by oxidative stress to maintain genomic instability. This transcription factor is involved in the process of autophagy in cells through the deactivation of the mTOR pathway². This involvement in the autophagy of mitochondria may be one way to prevent cancer caused by the production of reactive oxygen species. This research aimed on finding the effects of KLF4 on the levels of dysfunctional mitochondria in mouse embryonic fibroblasts (MEFs). We looked at levels of proteins that indicate dysfunctional mitochondria. We also looked at the effects of different drug treatments on the levels of dysfunctional mitochondria in the MEFs.

Results of this study demonstrate that Klf4-null MEFs exhibit impaired autophagy during starvation and impaired mitochondria at the basal level. Upon different drug treatments the levels of PINK1 are generally higher in cells without KLF4 than those with KLF4. This relates to impaired autophagy in KLF4 null cells as PINK1 tags dysfunctional mitochondria and those dysfunctional mitochondria are present in higher amounts in cells with impaired autophagy. The results we saw in MEFs also were seen in RKO cells upon the activation of the KLF4 gene. Mitigated characteristics of the KLF4 null cells were seen after transfection with GFP-KLF4.

Source of Support:  □ AHUM Div.  □ NASC Div.  □ SOSC Div.  □ UNST Div.  ☑ Other (specify): Michael J. Wolk ’60 Heart Foundation
Glial cells are an essential component of the central nervous system and work to support, nourish and regulate neurons. Two major types of glial cells are microglia and astrocytes. Microglia, as the resident macrophages of the brain, clear waste and act as the first line of defense against pathogens that cross the blood brain barrier and enter the brain. Astrocytes are important in managing the blood brain barrier, regulating extracellular ion levels, and repairing damaged tissue following neuronal injury. RAW 264.7 cells are a macrophage-like cell line that is developmentally related to microglia. During an immune response in the brain, the NF-κβ signaling pathway is triggered increasing the transcription of inducible nitric oxide synthase (iNOS) resulting in higher levels of the proinflammatory NO molecule. Proinflammatory cytokine levels are also higher in the brains of people with Major Depressive Disorder during a period of depression.

Selective serotonin reuptake inhibitor (SSRI) and tricyclic (TCA) antidepressants may be affecting this immune response. Past studies have shown that fluoxetine may be acting as a serotonin (5HT) agonist, thereby activating the serotonin receptor without the presence of 5HT. Given that fluoxetine (FLX) might be acting as an agonist for serotonin receptors, the 5HT-2A, 5HT-2B and 5HT-2C receptor agonist, meta-Chlorophenylpiperazine (mCPP), was also investigated.

Fluoxetine (20µM), nortriptyline, a tricyclic antidepressant (20µM) and mCPP (200µM) treatments caused a 250%, 100%, and 250% increase, respectively, in nitrite release from primary mixed glial cultures prepared from 2d rat cerebra. However, in RAW 264.7 cells, fluoxetine (20µM) and mCPP (400µM) treatments caused a 30% and 75% inhibition, respectively, of nitrite release. The astrocytes in the mixed glial cultures may be secreting a factor following stimulation with fluoxetine or mCPP that could affect the synthesis of iNOS in the microglia, thus causing the increased nitrite release. In the future, we would like to use a range of serotonin agonists and antagonists to further explore the relation between serotonin receptor activation and nitrite release in mixed glial cultures and purified cultures of microglia and astrocytes.
Project Summary:

The number of individuals, particularly youth, living into adulthood infected with the HIV virus is rising in Kenya (see Brady et al., 2010). This is due to the fact that individuals living with HIV are being enabled to live longer with help from increased access to effective medication and care. There is a new need to focus on the care and welfare of this growing population within Kenyan society. One important dimension of health care for persons living with HIV is disclosure, or explaining to children that they have HIV and what this means for their life and future. Pediatric HIV disclosure however, is a complex and challenging process. Primary caregivers of HIV positive children are responsible for this disclosure in Kenya, and it is important that the caregivers receive adequate support and resources to successfully move through the process. The purpose of this study is to analyze the resources and support available for these individuals during this process in the Kenyan setting, and the implications of differences in those resources for the process of disclosure.

Pediatric HIV disclosure is associated with increased adherence to medication, more social support for youth and better and more informed health decisions (see Bikaako-Kajura et al., 2006; Vreeman et al., 2014; John-Stewart et al., 2013). However, pediatric HIV disclosure in Kenya remains low among most populations for which research has been conducted (see John-Stewart et al., 2013; Vreeman et al., 2014). Caregivers often worry about factors such as stigma and negative mental health effects for youth. Detailed guidelines are not widely available to explain the appropriate ways and ages at which to disclose to children or youth within the Kenyan society and cultures. This study aims to specifically discover what resources and support are currently available to aid in this difficult process, what resources and support are needed to improve disclosure in the Kenyan setting, and whether personal HIV status and acceptance of status of caregivers affects the resources they desire to disclose to children and youth.

This study was framed by a grounded theory perspective using primarily qualitative approaches for data collection. Semi-structured interviews were conducted among (a) caregivers of HIV positive youth and (b) health care providers working with HIV positive youth at the Kenyatta National Hospital Comprehensive Care Centre (CCC) located in Nairobi, Kenya. The CCC serves only HIV positive individuals, and offers a variety of services to these individuals including support groups, counseling, social events, nutrition services, as well as a variety of medical resources. Currently, the CCC serves 981 ‘youth’ patients from infancy to 21 years. Upon receiving IRB approval through both Colgate and the Kenyatta National Hospital Ethics and Research Committee, interviews were organized with the support of the CCC. Caregivers were recruited for participation in the study as they were in waiting areas; health providers (doctors, clinicians, counselors, psychologists and peer mentors) were recruited throughout the clinic. A total of 21 interviews were conducted (10 health providers and 11 caregivers).

Preliminary analysis of interview data shows that at the CCC a variety of support services are available to both caregivers and children/youth throughout the disclosure process. These services, however, are not widely available at all clinics in Kenya. One of the biggest barriers to pediatric HIV disclosure, as is largely documented in literature, is fear by caregivers of negative emotional reactions by children, rejection and blame from children and simply how the children will react. From the data collected, it seems that this fear stems largely from the negative education children are receiving regarding HIV in primary school, resulting in increased stigma towards the virus. These results suggest that a helpful resource to pediatric HIV disclosure is improved education in primary schools on HIV in Kenya. In addition, the positive influence of seeing others who are HIV+ overcome challenges was evident in the data collected. More frequent showcasing of HIV+ caregivers who have successful disclosed to their children would be an extremely valuable resource in aiding the pediatric HIV disclosure process in Kenya. Results also suggest that how caregivers feel about their own HIV status influences the perspectives of caregivers about the timing and form of pediatric HIV disclosure, and their confidence in their ability to disclose effectively. Further and more complete analysis of data to obtain final results is ongoing.

Rábida Island in the Galapagos has experienced both explosive and effusive volcanism. It is located to the east of the most active volcanoes of the Galapagos, and previously determined ages range from 0.9 to 1.1 Ma. An unusually curved escarpment cuts the western sector of the island, which might be part of a caldera wall, although its radius of curvature is much greater than the radius of the island. Lavas range from basalt to rhyolite, and there are also several intermediate compositions, which are unique in the archipelago. A welded ignimbrite crops out in northeast sector, the only such deposit known in the entire region. The volumetric proportion of evolved rocks is unusually high: 25% of the rocks in our comprehensive sample set are intermediate to felsic. The siliceous rocks occur in two clusters in the southern and southwestern sections of the island, suggesting two separate sources. The intermediate rocks occur in the center and northwestern parts of the island. Despite these foci of more siliceous lavas, basalt is the most widespread rock type over the entire island. It is notable that Rabida is immediately east of Volcan Alcedo, which is the only active volcano that has also erupted rhyolite, and south of Santiago, which erupted the trachyte dome observed by Charles Darwin in 1835. These observations, in conjunction with the cumulate xenoliths found in explosive deposits, are consistent with the evolved rocks resulting from fractional crystallization of a dying magma chamber, as the volcano is carried away from the hotspot.
Research Fellow:  Daniel Berry (2017)  
Faculty Mentor:  Padma Kaimal  
Title of Project:  Kailasantha Temple Book Manuscript

Project Summary:
This summer I have been working with Professor Kaimal on diagrams for her next book manuscript. She makes the argument that the sculptures in the temple can be placed into two complementary categories based upon the direction they face. These categories, mangala and amangala, can be translated as auspiciousness and inauspiciousness. My primary focus has been to use the images she collected of the Kailasantha Temple in Tamil Nadu, India, and create intuitive ways of demonstrating the positions and locations of sculptures around the temple. Through this process, I have been able to help Professor Kaimal visualize her arguments clearly, while also learning a tremendous amount, not only about south Indian art during this time period, but also about how I think about my own artwork as a Studio Art major.

When first beginning to think about the best way to approach this task, I began with how would it best be presented in a lecture. Using Prezi, an online presentation platform, Professor Kaimal and I began to fill in different parts of the temple with images of the sculptures. The advantage to using Prezi is both that it is accessible from anywhere with a wireless connection, but also that the platform allows the presentation to physically move around the temple.

From this point, it was fairly straightforward to use the same images that were used on the Prezis, and create a static image that will be used in her manuscript. As is shown in the provided diagram, there can be a lot of information to convey within an illustration. Much of the work played with the intersections of the size of the image on the page, the amount of information displayed, and the clarity of the diagram in relation to the argument put forth by Professor Kaimal. By the end of the summer, I created twelve different Prezi presentations, and twenty-five diagrams for Professor Kaimal’s use. Working with Professor Kaimal on her research has been an undeniably rewarding experience. I have learned much more than I would have thought at the beginning of summer. The intricacies of the temple would have been completely lost on me before the summer, having not yet taken a course on the region and time period. After working so closely with the images and Professor Kaimal, I am continually astonished by the amount of planning that went into the layout of the temple and the sculptural images within it. It has been a remarkable experience working on the diagrams for Professor Kaimal’s manuscript, but maybe even more remarkable that she is pointing out all of the work that went into the temple roughly 1,400 years ago.


LEGEND:
- Indicates location of the temple structure
- Connects the image of the sculptures to their location on the temple
- Numbers in top left corner of images correlate to the numbering system established by archaeologists
Research Fellow: Kayleigh Bhangdia (2016)  Concentration(s): Geography; Environmental Studies
Faculty Mentor: Julie Dudrick  Department: Upstate Institute
Title of Project: Field School Fellow with Madison County Health Department
Project Summary:
By mapping the distribution of private water wells in Madison County as well as possible sources of ground water contamination, I was able to highlight at risk properties and assist the planning department with recommendations to homeowners.

I worked directly under the Environmental Health division as a GIS (Geographic Information System) analyst. I was able to combine my love and experience of GIS with my interest in environmental studies. I used GIS for a variety of purposes and some of my minor projects ranged from adjusting the location of a proposed gas compressor, helping with a grant for funding through the CDC (Center for Disease Control), determining the water source of approved septic systems before mapping them, and assisting with a public health project by mapping breast feeding versus formula feeding throughout the county. My main project that I was assigned to, and the one I spent the most amount of time on, related to drinking water throughout the county and the location of either public or private water sources. I predominately used the ArcMap software for these projects but I also made use of a pictometry software called Electronic Field Study, a county level property tax database, and Microsoft Excel.

Since Madison County is composed of many rural communities, not everyone has access to public water. Private well water does not need to abide by the Clean Water Act and there is no regulation in place that is concerned with the testing and treatment of private wells. I created maps that graphically represent the distribution of public and private water sources as well as maps depicting possible environmental contamination sites. Figure 1 was created by using information provided by the Department of Environmental Conservation and geo-locating all of the incidents by unique tax ID. To map the potential contamination sites, I used the addresses to determine the unique tax ID before selecting those parcels in the attributes table in the parcel shape file. Once I had them selected, I exported the table and calculated the geometry in order to determine the latitude and longitude of the parcels. I then used the toolbox to make an xy event layer which created points at the centroid of each parcel.

Once I was sent the table containing the water type each parcel had, I could easily input the excel file into GIS and create a map showcasing the information. I created inset maps to show detail for the cities/towns where there was a higher density of parcels. I also used excel to create pie charts that explored the distribution of water source that explored the location of either public or private water sources. I predominately used the ArcMap software for these projects but I also made use of a pictometry software called Electronic Field Study, a county level property tax database, and Microsoft Excel.

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Title of Project: Study of signaling in zebrafish lateral line development

Project Summary:

This summer I had the opportunity to get hands on experience working with neurodevelopment and regeneration. Specifically, my project focused on the posterior lateral line (pLL), which runs along the lateral side of the fish and consists of sensory hair cells comparable to the hair cells within the human ear. Each bundle of hair cells along the lateral line is situated within a group of support cells and further surrounded by the outermost mantle cells to complete a sensory organ known as a neuromast. Fish use these hair cells to detect changes in water direction via deflection, similarly to how cochlear hair cells detect changes via sound wave deflection. Although the lateral line hair cells are structurally similar to mammalian hair cells, mammalian hair cells do not maintain the ability to regenerate in response to injury. The ability to regenerate has made zebrafish a popular model of study for many labs, and after my exposure this summer I would like to continue working with this model in the future.

While zebrafish are fascinating for many reasons, my project focused primarily on developmental aspects of the posterior lateral line and the manipulation of signaling pathways in relation to sensory cells. During development, neuromasts are deposited by a migratory primordium with Wnt positive mesenchymal cells at the leading edge and FGF positive cells forming into epithelial rosettes at the depositing end. Because Wnt and FGF play such a key role in the development of the system, we manipulated the two signals within deposited neuromasts and found that by pharmacologically inhibiting FGF signaling with the drug PD and activating Wnt signaling with the drug Azakempalone (Az), we are able to study and manipulate the transition between epithelial and mesenchymal cell types. Interestingly, this combination of FGF inhibition and Wnt activation causes the neuromast to spread from a compact circle into an elongated oval, and even more interestingly removal of the drugs allows the neuromasts to reconstitute. This is a fascinating phenotype because it allows us to study the reversal of a support cell to a stem cell, and back to a support cell again.

Hypothesizing that the established cells may be reverting back to a leading edge-like mesenchymal cell type, I used a Siam:GFP fish line to visualize the activation of Wnt signaling (data not shown) and found that when both drugs were uses all of the cells expressed Wnt. Interestingly, I also found that when only FGF was inhibited the outermost cells appeared to express Wnt, even though when only Wnt was turned on there was not Wnt reporter fluorescing. To further investigate this I used an Et20:GFP fish line to selectively visualize mantle cells, which are the outermost neuromast cells (Fig. 1). Again, when only FGF signaling was inhibited the mantle cells began to adapt a mesenchymal phenotype, but when only Wnt was activated the cells remained epithelial. This shows us that within the normal neuromast there is underlying Wnt signaling within mantle cells that is normally inhibited by FGF signaling and therefore goes undetected. I am excited to continue this research for my honors thesis and hope to identify more specifically where within each signaling cascade the two are interacting, as well as how these signals coordinate to re-establish neuromasts after drug removal.

Research Fellow: Anne “Maddy” Canning (2018)  
Concentration: Undeclared

Faculty Mentor: Graham Hodges  
Department: History

Title of Project: Self-Emancipation in American History: Beyond the Underground Railroad

Project Summary:

My research can be broken down into three parts. The first was a week in Trenton looking through New Jersey State Supreme Court records. The second part was a week in Washington D.C. at the National Archives looking at pension records for soldiers who served in USCT (United States Colored Troops) regiments during the Civil War. The majority of my research was spent confirming a list of Liberty party members from a list contained in Reinhard O. Johnson’s book The Liberty Party, 1840-1848: Antislavery Third-Party Politics in the United States.

During the week in Trenton, New Jersey, I got my first introduction to a professional archive. I was introduced to the process of call slips and the running of an archive. I was able to handle original documents that dated as far back as the colonies when cases were titled “Negro Tom v. The King,” for example. I also experienced true cursive for the first time. A big part of the week was struggling to read the handwriting in the old documents because I was not accustomed to old American script.

During my week in Washington, D.C., at the National Archives I looked into the pasts of many former soldiers. Pension records show all pertinent information about a person’s application for a pension. For example, the files included a doctor’s statement where the doctor stated his opinion on the health of the patient and the doctor’s opinion on the needs of the patient. Some of the files were rather extensive, either because there were lots of personal letters or statements or because the person was applying for more than one type of pension, such as an invalid’s pension, for the former soldier, and a widow’s pension or a dependent child’s pension. Perhaps the most interesting application process I read through in the various files I looked at were the applications for dependent parents. The process for proving one’s dependence on the child was quite extensive and included many depositions and other legal processes.

The majority of my research was spent looking at historical newspapers to confirm the various facts we have about a Liberty Party member based on the claims Reinhard O. Johnson makes in his book, The Liberty Party, 1840-1848: Antislavery Third-Party Politics in the United States. Essentially, I used historical newspapers, from the database America’s Historical Newspapers and a few other databases, to confirm the information provided about people in Johnson’s book. For example, if the book states that the person declined the nomination for vice president in favor of another candidate I had to find newspaper articles that supported this claim.

All in all this summer was a tremendous experience and a wonderful introduction to the types of research one can do in the field of history. Additionally I was able to work with amazing people in equally amazing places such as the National Archives.

Source of Support:  
☐ AHUM Div.  ☐ NASC Div.  ☒ SOSC Div.  ☐ UNST Div.  
☐ Other (specify):
Research Fellow: Michelle Cao (2016)  Concentration: Economics
Faculty Mentor: Julie Dudrick  Department: Upstate Institute
Title of Project: Field School Fellow with Cornell Cooperative Extension-Madison County

Project Summary:

In 1862 Congress passed legislation to provide land for chosen universities to teach and educate its communities; the land grant institution chosen for New York state was Cornell University. Each county opened a Cornell Cooperative Extension (CCE) office with an overarching mission of bringing knowledge of ecological sustainability, economic vitality, and social well being to New York state families and communities to reach solutions that will benefit the community.

The workforce in agricultural and farming occupations are on a downward trend. In order to tackle this issue, internships can be given to students and young people to promote and encourage entrance into the agricultural industry. To facilitate this in Madison County, I researched workforce trends in agriculture and farming, compared similar internship positions, and developed guidelines for an internship program to be implemented between local Madison County farms and Madison County institutions of higher education. The Agriculture, Forestry, Fishing and Hunting industry is defined by the U.S. Bureau of Labor Statistics (BLS) as establishments engaged primarily in crops, animals, timber, and fish and other animals. This industry by occupation is currently one of the smallest occupational groups, making up less than 1% of total employment. Farming, Fishing and Forestry is also one of the lowest paying occupational groups, which include food preparation and serving related occupations and personal care and service, each with an annual mean wage of $25,000 or less. The industry unemployment rate peaked around 20% in January 2010 but has since generally been decreasing to a rate of 7.6% in June 2015. According to the BLS, every major occupational group except Farming, Fishing and Forestry is projected to gain jobs between 2012 and 2022.

For the specific occupation under Farmers, Ranchers, and Other Agricultural Managers, job outlook is expected to decline 19% from 930,600 in 2012 to 750,700 in 2022. This decrease in employment might be due to the consolidation of farmland into larger and more efficient farms or farmers just leaving the profession; despite this decrease, there has been an increase in the number of small-scale farmers performing successfully in trending market niches that involve direct contact with their customer base, like organic food production and horticulture. Others use farmer’s markets or join CSA (Community Supported Agriculture) cooperatives to communicate personally with their urban and suburban consumers; some also participate in collectively-owned marketing cooperatives that process and sell their products.

New York state’s location quotient (quantifying how concentrated a particular industry is in a region compared to the country) of farming, fishing, and forestry occupations is 0.13. Farming, fishing, and forestry occupations in New York state have median hourly wages of $13.29, mean hourly wages of $15.55, and annual mean wages $32,350. Syracuse’s farming, fishing and forestry occupations, including those in Madison County, have a concentration of 0.17, slightly higher than the entire state’s location quotient. Syracuse has a slightly higher concentration of individuals working in farming, fishing and forestry occupations compared to the state.

After looking at comparative agricultural internship programs, I have found that there is a need for such an internship program in Madison County and could be modeled after the Cornell CALS NYS Internship program and the Colgate University Upstate Institute, where the institutions link students to local businesses while also helping the community. The idea of the internship program is based on the Foreign Agricultural Service’s international internship program, where the FAS acts as the main headquarters sending “ambassadors” abroad. The data on industry trends and outlook is taken from the U.S. Bureau of Labor Statistics and the Cornell Chronicle.

**Research Fellow:** Abril Cardenes (2017)  
**Concentration:** Sociology

**Faculty Mentor:** Melissa Kagle  
**Department:** Educational Studies

**Title of Project:** Paranoia at the University

**Project Summary:**

This project comprised a review of the literature on the influence of current political climate on policies pertaining to postsecondary education. The goal of the research was to develop themes that cross boundaries between the concerns of the academy and that of democratic societies more generally, with a focus on discourses of agency and the free exchange of ideas on one side and control and protectionist impulses on the other. The literature revealed parallels between societal responses to an indeterminate yet pervasive threat such as post-9/11 policies of new limitations on civil liberties and increased surveillance with the posturing of universities in the face of evolving norms of what constitutes academic freedom, protected speech and campus safety concerns. These themes form the basis of a developing theoretical construct of universities as embodying the paranoid empire of the security state and its varying apparatuses of control.

The first step in the project was to conduct a general survey of the landscape of university policies concerning freedom of expression, protections for vulnerable populations and resulting litigation resulting from conflicting views in these areas. This review of the available literature and policy documents surfaced disparities in college policies based on gender, race and class with punitive measures falling most substantially on student populations who do not conform to majority race and class backgrounds.

After developing a base of understanding about the conflicts inherent in institutional responses to the evolving landscape of academic norms and expression, these same themes were searched for within national discourses in the immediate aftermath of 9/11. This was accomplished through a key word analysis of newspaper stories of the era concerning terrorism and civil liberties. A word and concept frequency analysis was done based on a review of articles in the New York Times. These results were then compared to those generated in the review of literature on post-secondary institutions yielding cross-case themes of institutional confidence in the face of a perception of pervasive threat as a cover-up for underlying paranoia and reactionary response.

The final stage of the project, which was not completed in the course of the summer research, will be to more fully develop a theory of predicted institutional responses to a climate where norms of academic freedom and tolerance of opposing views and difference are in competition with perceptions of a threat to safety and social order, resulting in a need for reductions in civil liberties and increased surveillance on the part of institution.

**Source of Support:**  
- AHUM Div.  
- NASC Div.  
- SOSC Div.  
- UNST Div.

- Other (specify):
Research Fellow: Aurelia Casarrubias (2017)  Concentration: Geology
Faculty Mentor: Amy Leventer  Department: Geology

Title of Project: Recent change in diatom populations recorded in sediments from the Larsen A Embayment, Antarctica

Project Summary:

Over the past several decades, ice shelves on both sides of the Antarctic Peninsula have catastrophically disintegrated. This project looked at marine sediment cores collected from the Larsen A embayment, eastern Antarctic Peninsula, a site previously occupied by the Larsen A Ice Shelf. The goal of this project was to determine the recent history of the ice shelf, in order to evaluate the history of the Larsen A Ice Shelf through the use of diatoms as a proxy recorder of oceanographic conditions. Cruise NBP1203 collected several multicores from the region; these cores preserve the uppermost sediments from the sea floor. The absolute abundance and assemblage composition of diatoms was analyzed at 1-centimeter increments. The data demonstrate the rapid increase in diatom abundance within the uppermost centimeter, associated with the loss of overlying glacial ice shelf. Lower diatom abundances beneath the upper centimeter reflect the advection of low concentrations of diatom frustules underneath the ice shelf. The diatom assemblage is fairly uniform throughout the cores, suggesting only minor variability in sea surface conditions prior to ice breakout.

Research Fellow: Julia Ceglowski (2016)  
Concentration(s): Mathematics; Biology

Faculty Mentor: Evelyn Hart  
Department: Mathematics

Title of Project: Endomorphisms of the Fundamental Group of the Double Torus

Project Summary:
This summer I was fortunate enough to gain experience in math research. I learned the process of independent research and was able to dive into a subject I knew little about and come out with a great enough understanding to contribute to the subject. I spent time reading graduate level material, learning from Professor Hart, and working with computer code, written by Ha Vu, to discover patterns. This all helped me to work on my problem, which has led to me gaining a strong intuition in the subject as well as an understanding of the complex progression of math research.

Algebraic topology is a subject in which topological spaces are studied through algebra using group theory. My goal was to classify all the endomorphisms on the fundamental group of the double torus. The double torus (or double-doughnut) is the topological space we are currently studying. The reason we are studying the double torus is because it has a challenging fundamental group compared to other spaces previously studied. The fundamental group of the double torus, which we call $\pi$, is a four-generator group with one relator, $R$. Formally, $\pi = \langle a, b, c, d; abABcdCD = 1 \rangle$. The group operation is concatenation, so this means 'words' are formed by putting any string of $a, b, c, d, A, B, C, D$ together (where $A$ is a inverse and so forth). So $\pi$ is the group of all finite words formed by these four generators, and $abABcdCD$ is equal to 1.

An endomorphism is a function from a group to itself with the property that $f(xy) = f(x)f(y)$ and $f(1) = 1$. So any endomorphism on $\pi$ is determined by $f(a), f(b), f(c),$ and $f(d)$. This is because the image of any word under $f$ can be broken down, and we will only need to know how $f$ works on our 4 generators.

A function $f$ will be an endomorphism on the fundamental group if and only if $f(R) = 1$, and thus in order for there to be an endomorphism $f(abABcdCD) = f(a)f(b)f(A)f(B)f(c)f(d)f(C)f(D)$ must equal 1. So I am categorizing all the choices for $f(a), f(b), f(c), f(d)$, (which we call $w, x, y,$ and $z$ respectively) that will make $f(R) = 1$.

We have the following categories:

Type A: At least one of $w, x, y, z$ is 1. There are subclasses depending on how many and which variables are 1. I have found all the endomorphisms of this type.*

*For all other types, none of $w, x, y, z$ is 1.*

Type B: $f(R)$ reduces to 1 and no Dehn reduction is necessary.
I have found some endomorphisms of this type; more work in this category will be needed in future research.

Type C: There exists $q$ in $F$ (Dehn reduced) and a cyclic permutation $P$ of $R$ or $R^{-1}$ such that $f(R)$ reduces freely to $qPQ$ (in $F$), and thus one application of Dehn reduction gives $f(R) = 1$ in $\pi$.
I am currently working with this type attempting to prove there are only a few places $R$ can be in $wxWXyzYZ$, and therefore we will be able to find all the endomorphisms of this type.

Type D: There exist $q_1, \ldots, q_n$ in $F$ (Dehn reduced) and cyclic permutations $P_1, \ldots, P_n$ such that $f(R)$ reduces freely to $q_1P_1Q_1\ldots q_nP_nQ_n$ and thus $n$ applications of Dehn reduction gives $f(R) = 1$ in $\pi$. I predict that there will not be any endomorphisms of this type. This would then mean there would only be three types of endomorphisms, and future research could involve finding all of them in our set number of categories.

Source of Support:  
☐ AHUM Div.  ☒ NASC Div.  ☐ SOSC Div.  ☐ UNST Div.  
☐ Other (specify):
Research Fellow: Tia Cervarich (2016)  
Concentration: Chemistry

Faculty Mentor: Anthony Chianese  
Department: Chemistry

Title of Project: Investigating Catalysts for the Hydrogenation of Polar Bonds

Project Summary:

With the world’s oil and natural gas reserves quickly being depleted, scientists are looking for new energy sources that could someday replace fossil fuels. One fuel that has emerged as a front-runner is hydrogen. It can be easily produced using solar energy, efficiently releases stored energy, and produces only water for waste. However, hydrogen is hard to store and transport. As a gas, it requires extremely high pressures to store, and in order for it to be stored as a liquid, the temperature needs to be near absolute zero (-273°C). Both of these eat energy and are impractical for widespread use. However, these are not the only ways hydrogen can be stored. Chemical storage is a real possibility that many laboratories, including our own, are looking into. Chemical storage entails hydrogenating a compound and then later removing that hydrogen. For instance, carbon dioxide can be hydrogenated to form methanol and water and then dehydrogenated to reform carbon dioxide and hydrogen gas. But to do this reaction efficiently, a catalyst is needed.

I began this summer by trying to optimize and design catalysts for ester hydrogenation reactions. I first worked to perfect the synthesis and catalytic reactions of our CNC catalyst. We made significant progress and our results looked promising, but we had to abandon the project when another research group published a catalyst of the same design. Next, I moved to a similar project. All of our catalysts to this point have used ruthenium at the reactive center. The issue with this is that ruthenium has a very low abundance on earth and is thus very expensive. Therefore, we decided to try to make our catalysts using more abundant and less expensive first-row metals like iron and nickel instead. But instead of going through the lengthy process of synthesizing and isolating compounds that we weren’t sure would be catalytically active, we followed an procedure where the in-situ catalyst was used in catalytic trials. Only if we saw significant conversion of the ester to the alcohol would we follow up on a catalyst. Unfortunately, this approach leaded no hits and we abandoned it altogether.

To end the summer, I began working on a collaborative project with a colleague of Professor Chianese. We were sent some samples of catalysts that were active for other types of hydrogenation reactions so that we could test them in our reaction set-up. I am testing these catalysts with a variety of substrates to see if any are active for reactions of interest to us. So far, we have seen some positive results. Moving forward, I will continue working on this project.

Source of Support:  
☐ AHUM Div.  ☑ NASC Div.  ☐ SOSC Div.  ☐ UNST Div.  
☐ Other (specify):
Research Fellow: Abeneazer Chafamo (2017)  Concentration: Computer Science

Faculty Mentor: Michael Hay  Department: Computer Science


Project Summary:

We took part in research on the privacy aspect of machine learning algorithms. Machine learning is a subfield of artificial intelligence that focuses on recognizing and learning patterns from real data in order to make predictions. For our research project, we were particularly interested in classifiers. A classifier is a machine learning method that uses pattern matching to attempt to assign a label/class to an observation. For example, classifiers can be used to label an email as spam, to predict a patient’s risk level for a particular disease, etc. In certain cases, data that is used to build these classifiers is sensitive (e.g. medical data) and people need a privacy guarantee before they volunteer their data. One of the most prevalent methods of trying to ensure privacy is anonymization or the removal of personal identification information. But when a health insurance company in Massachusetts released the anonymized records of its employees, people were able to go back and re-identify certain records. We see that anonymization doesn’t provide sufficient privacy, thus we need a more robust method of privacy.

Differential privacy is a proposed alternative to anonymization. It ensures that computations be insensitive to changes in an individual’s record. Differential privacy achieves this by adding noise to the statistical computations. There has been much research in the past on differentially private classifiers; however, there has not yet been a comprehensive study of the existing differentially private classifiers. The goals of the project were to look at the current algorithms in the field and do an empirical comparison and to propose possible improvements to current algorithms. We also collected and curated datasets, both new ones and those that have previously been used in other papers. We were able to obtain some preliminary results after running the differentially private classifiers that we had on our collection of datasets.

One part of the task for this summer was to come up with our own ideas for individual side projects within the scope of the research topic. Since we had been implementing existing differentially private classifiers, I thought I would try and improve the performance of a classifier algorithm of my choice. To this end, I chose the decision tree, which we had spent considerable time on. I had ideas on where I can make these improvements, so for the next couple of weeks I worked on making those changes and also running experiments to test the added features. Adding a new stopping criterion for the decision tree, keeping track of the privacy budget and a new continuous-attribute handling feature were among the suggested changes. After running our version of the decision tree code on some datasets, we realized that some changes proved more useful than the others. Especially our new continuous-attribute handling feature highly improved the performance of the decision tree on datasets with abundant numeric attributes.

![Figure 1: Comparison of the two continuous attribute handling methods](image)

Title of Project: Drawing: “The Elephant in the Coding Room”

Project Summary:

Graphical user interface (GUI) is the dominant form of interface that defines user experience with modern computers. Regardless of that, introductory computer science classes seldom mention this mode of interaction. There is a significant gap between what students associate with computers (2D and 3D graphics, GUI) and what is actually programmed in the classroom (textual input and output). This project investigated approaches to bridge that gap.

Graphics packages and language features that support non-trivial drawing usually require an overwhelming amount of mathematical and computational knowledge to use. Computer science departments, as a result, tend not to offer graphics-intensive courses until advanced undergraduate level classes. Processing, a programming language and environment for visual artists and designers, drastically simplifies the drawing of static and animated images. Processing, however, runs in its own integrated development environment. The Processing language itself is only a simplistic, non-standard dialect of Java. Therefore, it is difficult to use Processing as an instruction language at Colgate, as it lacks many complex features and data structures of standard programming languages. Our project is to do the reverse of what Processing sought to do - to create a powerful but simple graphics library (to be used in standard Python and Java environment) that is tailored for novice programmers.

Processing approaches drawing in a declarative manner. Everything is defined in terms of functions that draw primitive shapes and change the drawing context rather than methods that change the state of an object. We found this to be an intuitive and fruitful framework to try and incorporate into native languages that do not support such simplistic graphical operations. Initially, we envisioned for the application programming interface to be a strict subset of Processing, thus we used Processing as a benchmark. Doing so, we also make sure that our implementations in two different languages and using two different renderers yielded similar results. This evaluation, in return, permits us to trace bugs and make improvements in our implementations and also in the Processing language.

The Java version of the library uses the default Java AWT and Swing features while the Python library uses a Python binding of the Cairo graphics library and Pygame for interaction. We hope to continue working on this project during the semester and include various improvements such as reducing dependencies for the Python library and increasing the number of functionality in the Java implementation.

Research Fellow:  Prosper Chitongo (2017)  
Concentration:  Mathematics

Faculty Mentor:  Julie Dudrick  
Department:  Upstate Institute

Title of Project:  Field School Fellowship with Fiver Children's Foundation

Project Summary:

The Fiver Children's Foundation is a comprehensive youth development organization that makes a 10-year commitment to children from underserved communities throughout New York City and central New York. Through character-building summer and year-round out-of-school time programs, Fiver empowers children to make ethical and healthy decisions, to become engaged citizens, and to succeed in school, careers, and life. Fiver works with 500+ students ages 8 to 18, one hundred percent of whom, upon enrollment, qualify for free or reduced lunch at school. In addition to coming from economically disadvantaged circumstances, Fivers face other daunting and complex challenges of poverty. More than half are being raised by single parents and many have had to learn English as a second language. Most Fiver students come from groups under-represented in higher education and professional careers, have few examples of academic persistence and are hoping to be the first in their family to attend college.

Fiver bases their programs on measurable outcomes, and they conduct internal and external evaluation and research projects that have led to improved program practices. In the last five years, they have adopted a Theory of Change model that depicts the journey of a Fiver student from the initial referral to graduation at age 18. Behind the model is a matrix of outcomes and measurement tools. A Program Evaluation Manager works with Fiver to utilize the Theory of Change, its associated measurement tools and the resulting data to the fullest extent possible. This data includes demographic information, program attendance and retention records, and survey responses. My responsibility this summer was to work with this Evaluation Manager to assist with administering Fiver’s program evaluation plan.

My responsibilities included becoming familiar with Fiver’s Theory of Change and with the Youth Survey that is administered throughout the summer; assisting in developing a survey implementation schedule to ensure that all eligible Fiver students complete the age-appropriate survey during their stay at Camp Fiver; and preparing new technology (tablets) for administering the Youth Survey. I then administered this survey to the campers over the first two sessions of the summer program, ensuring they had proper instruction in how to complete the survey. I also helped the camp director to guide program participants in administering the Camp Program Quality Assessment tool created by the American Camp Association.


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Project Summary:

Faculty at many universities face the decision of whether to unionize and form a collective bargaining agreement. An important determinant of that decision is the impact that unionization would have on faculty salaries. I attempt to measure that impact by comparing faculty salaries at similar, large public universities, which have formed faculty unions in different points in time. I use a difference in difference model to find a causal link between faculty unionization and faculty salaries.

In my sample I use the faculty at the University of Oregon, which unionized in the year 2013, as the treatment group and the faculty at the universities Eastern Illinois University, Western Illinois University, Northeastern Illinois University, Illinois State University and Governors State University as the control group. I use a difference in difference model so that I am able to identify the impact of faculty unionization on salaries, while controlling for time trends in faculty salaries, and for nationwide specific factors that may impact the whole public education system. The underlying assumption for the difference in difference model is the parallel trends assumption. In this case, the parallel trends assumption states that the salaries of the treatment and control groups follow a similar trend before and after the collective bargaining agreement was ratified in October 2013. A visual inspection of the data supports this assumption, and also shows that the University of Oregon enjoyed a slightly larger bump in faculty salaries in 2014. I use the consumer price index for Oregon and Illinois to calculate inflation adjusted salaries and control for cost of living differences between states.

The results indicate a 5.5 percent union salary premium for faculty base salary. The union salary premium decreases to a more modest but still significant 3.5 percent after adjusting for cost of living differences. The union impact on base salary is larger than on total compensation, suggesting that unionization has a lesser impact on fringe compensation for faculty. The results show union base salary premiums of 5.2 percent for professors, 6.8 percent for associate professors and 9.9 percent for instructors and lecturers. Assistant professors suffer a negative 7.5 percent decrease in base salary as a result of the union. This presents the possibility that a negative salary impact on assistant professors could have been the source for funding salary premiums for other faculty ranks.

This summer I've been observing and analyzing images of Blazar 3C454.3. As a physics major, I came into the project with only introductory knowledge of Active Galactic Nuclei, the category of galaxies that includes quasars and blazars. To understand how cosmology pertains to blazars, we need to know how fast the universe was accelerating when the light was emitted from the blazar versus how fast it is accelerating now. Since our quasar's light is around 7 billion years old, the universe was in fact decelerating when the light we are currently looking at was emitted.

Additionally, twice a week I observed at the Foggy Bottom Observatory, obtaining images for a few different quasars. Images varied in brightness from day to day, which was evident in the images, even from day to day. We combined the data we obtained from the pictures taken at night to the historic light curve shown below. This curve shows how blazar 3C454.3 varied in brightness over the past one hundred years using data from a few different references. Looking at the big picture, the brightness of the blazar over time will tell us more information about the energy emitted from the supermassive black holes at the center of these galaxies.
Research Fellow: Dyani Davis (2018)

Concentration: Educational Studies

Faculty Mentor: Frank Frey

Department(s): Biology; Environmental Studies

Title of Project: Self-Authorship For Black Woman On College Campuses

Project Summary:

The focus of my research this summer was on the process of self authorship for Black women on elite college campuses; looking specifically at the performance of identity and degrees of integration for Black women into elite environments of higher education on a social and political level. College is an extremely transformative period in which identities are formed. I was curious to analyze the role that these elite all white spaces play in this process for Black women.

I began with looking at the underlying concept of womanhood. The question I began with was “What is womanhood” in an American context; questioning what does it mean to come of age as a woman, and what exactly that entails.

This thinking lead me to narrowing in on the specificities of “Black Womanhood” and what exactly it is to be both Black and a woman in America. I focused specifically on what it means to come of age as a Black woman in America. In this process I looked at the intersectionality of race and gender and the levels of oppression and weight that are added on to this process of coming of age as a black woman, in relation to the historical context of both race and sex in America. In this process I gathered the majority of my findings through texts such as “Black Feminist Theory” by Patricia Hill Collins, “Women Race and Class” by Angela Davis, and “Black Women Identity and Cultural Theory” by Kevin Quashie.

I then specifically began looking at the processes of Self Authorship and Self Actualization, looking at how one forms their identity and then performs it as a result. There are two opposing forces in terms of this process on college campuses, one of which being the freedom to reinvent, and find your true self, and also the feeling of pressure to fit in or conform to the majorit for social survival, and sometimes literal. My research then took me to how these two opposing forces affect this process for Black women, specifically in all white, elitist spaces. I did this while analyzing the historical context of all white spaces in relation to black women and how that experience plays out in society today.

In researching these processes of self authorship and self actualization for Black Women on predominately white college campuses, I first began researching the specific experiences of Black Women. I began gathering data through the following texts: “Black Women in Undergrad” by Crystal Renee Chambers and “The Unchosen Me: Race, Gender and Identity Among Black Women in College” by Rachelle Winkle-Wagner.

I then collected eleven personal narratives from Black women currently enrolled in four year universities including five stories describing the Colgate experience, five stories from Black women currently attending institutions that are both elite and predominantly white spaces including Hamilton, Columbia, etc. Finally, the last two were narratives from public state university with far more diversity.

My research did not aim to tell the story of all black women in elite liberal arts institutions, the full account of all black women at this institution, nor the full stories of said black women. My goal is to provide glimpses into their lives and experiences.

My findings this summer were only the very beginning of my project, and I plan on conducting interviews as my next step, and then both looking at long-term effects, and long-term solutions.


☑ Other (specify):  Science and Math Initiative-SMI (NASC Division)
Emerald is a variety of beryl which is a cyclosilicate mineral. Cyclosilicates have a ring structure and these rings form a channel that CO₂ molecules can fit inside of. The focus of this project was to measure the ratio of two isotopes, carbon-12 and carbon-13, of the CO₂ inside the channel. The ratio is expressed in δ¹³C notation and the premise of the project was that this could act as a fingerprint of the conditions during emerald formation. An example of this is that organic materials tend to have a preference for ¹²C over ¹³C and this preference (or other similar isotope effects) could be inherited by the CO₂ in the channel when the emerald was forming. The emerald samples in this study are from important deposits around the world like Colombia, Brazil and Pakistan.

In order to not waste the emeralds a beryl sample was tested first. It was made into a powder and sub-samples were put into a furnace at 200°C, 400°C, 600°C and 800°C. When samples from the five different temperatures, including an untreated one, were analyzed there was a jump in δ¹³C values between samples treated at high and low temperatures. The untreated, 200°C and 400°C had δ¹³C values between -37 and -40‰. The 600°C and 800°C values increased to -23 and -22‰. We think that this jump shows the difference between the CO₂ that is not in the channel and is driven off between 400 and 600°C, and the CO₂ in the channel that remains to high temperatures. This means that the channel CO₂ that we wanted to analyze was not isolated until 600°C. The same process was repeated with two emerald samples and the jump between 400°C and 600°C was seen again. After this we proceeded with the other emerald samples, but they were only put in the furnace at 600°C. This was done because a few of the samples only had enough material for one analysis and the channel CO₂ was being reached at 600°C. Also, treating samples at 600°C left enough weight percent carbon to be reliably analyzed; the weight percent carbon was very low at 800°C. After the emerald samples were analyzed, the same process was done to other beryl samples.

The data show that there is a variety and range in the δ¹³C values within emerald and beryl samples. The δ¹³C data from the different locations were compared in hope of finding any similarities between sites with similar emerald forming processes. However, the results do not show an obvious conclusion or pattern within the same location or between locations with similar deposit types, or with previously published geochemistry.

<table>
<thead>
<tr>
<th>Emerald Sample Location</th>
<th>δ¹³C at 600°C</th>
<th>Beryl Sample Location</th>
<th>δ¹³C at 600°C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bahia, Brazil</td>
<td>-12.12‰</td>
<td>Gilsum, NH</td>
<td>-21.64‰</td>
</tr>
<tr>
<td>Bahia, Brazil</td>
<td>-14.09‰</td>
<td>Gilsum, NH</td>
<td>-23.04‰</td>
</tr>
<tr>
<td>Brazil</td>
<td>-25.80‰</td>
<td>Gilsum, NH</td>
<td>-24.01‰</td>
</tr>
<tr>
<td>Brazil (probable)</td>
<td>-23.46‰</td>
<td>Gilsum, NH</td>
<td>-18.43‰</td>
</tr>
<tr>
<td>China</td>
<td>-12.86‰</td>
<td>North Carolina Mountains</td>
<td>-14.12‰</td>
</tr>
<tr>
<td>Colombia</td>
<td>-6.83‰</td>
<td>Unknown 1</td>
<td>-11.39‰</td>
</tr>
<tr>
<td>Muzo, Colombia</td>
<td>-18.69‰</td>
<td>Unknown 2</td>
<td>-17.28‰</td>
</tr>
<tr>
<td>Nigeria</td>
<td>-20.68‰</td>
<td>Unknown 3</td>
<td>-6.49‰</td>
</tr>
<tr>
<td>Russia</td>
<td>-11.53‰</td>
<td>Unknown 4</td>
<td>-6.49‰</td>
</tr>
<tr>
<td>Swat, Pakistan</td>
<td>-8.23‰</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Synthetic Emerald</td>
<td>-20.16‰</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tanzania</td>
<td>2.33‰</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

This summer, I worked as an intern in the National Aeronautics & Space Administration’s History Program Office in Washington, DC. During the ten weeks that I worked there, I did not have a specific project that I was investigating, but rather a litany of different topics that I researched and wrote about. All of these topics concerned aerospace history, and they primarily focused on areas that reflected important achievements that NASA made this summer, creating ties between the organization’s past and its projected future. I turned several of these research topics into articles that can be viewed on the NASA website.

One of the most highly publicized space events this summer involved NASA’s New Horizons probe passing Pluto and finishing mankind’s quest to visit every major celestial body in our Solar System. The probe’s closest flyby occurred on July 14, exactly fifty years after Mariner 4 made the first successful flyby of Mars. Launching on November 28, 1964, Mariner 4 was the first spacecraft to approach another planet with a camera on board, sending back images to NASA of a cratered, Moon-like terrain drastically different than what scientists had expected to find. These pictures dashed the hopes of the scientific community that life would be easily found on Mars. However, the data collected was instrumental in planning future interplanetary missions, such as the New Horizons journey to Pluto. By connecting these two important firsts, I demonstrated how far NASA has come in its observation of the solar system in just half a century. I also composed a timeline of man’s exploration of Mars to celebrate Mariner 4’s fiftieth anniversary to further illustrate how our understanding of the Red Planet has shifted over time and how the lessons learned from these missions can prepare us for colonizing the planet within the next thirty years.

This year also marks the beginning of Astronaut Scott Kelly’s Year in Space aboard the International Space Station, and I wrote several pieces about man’s presence in lower Earth orbit and international cooperation in space to give this achievement historical context. For example, this summer, NASA commemorated the fortieth anniversary of the Apollo-Soyuz Test Project, in which an American crewed Apollo Command and Service Module docked with a Soviet Soyuz capsule. This was the first time that such a feat was accomplished, and it paved the way for future cooperation between the two nations, such as in the Shuttle-Mir program and currently aboard the ISS. I also wrote about the launch of the Russian Zvezda Service Module, an integral part of the early space station. Taking off on July 12, 2000 aboard a Proton rocket, this module served as the first living quarters for researchers on the station, and it was a major step towards allowing humans to live in space the way they do today. By linking these important historical developments with NASA’s current objectives, I illustrated how important NASA is in maintaining good diplomatic relations with other nations, reinforcing the United States’ need for such an important agency in the decades to come.

In conclusion, this summer I researched a wide variety of historical events from NASA’s past and connected them to the administration’s current goals. People often take for granted the great work NASA has done, and by drawing attention to its many accomplishments and important contributions, I tried to remind the non-scientific community of how essential an organization NASA is. I loved my time there, and I hope to stay involved with science policy in some way after I graduate.
Research Fellow: Jennifer “Jenn” Dias (2016)  
Concentration(s): Biology; Spanish

Faculty Mentor: Julie Dudrick  
Department: Upstate Institute

Title of Project: Field School Fellow with the Chenango United Way

Project Summary:

Chenango County is considered to be an economically disadvantaged region in New York State (NYS), having experienced numerous state and federal disasters in recent years. According to the 2013 National Census Bureau, Chenango County ranks the lowest at 60% below NYS per capita income levels, having the greatest concentrations of families below the national poverty level. As an underprivileged community, Chenango County also faces significant challenges in the healthcare realm. For example, there is one primary care physician for every 2,081 residents in the county, one dentist for every 2,912 residents, and there is only one dental provider who accepts Medicaid. Similarly, 33% of adults are considered obese.

Given the demonstrated medical need in Chenango County, the county received a grant for a medical Innovative Readiness Training (IRT) mission, led by the Department of Defense. Overall, as part of each IRT mission, the military serves high-need areas across the country, while partnering with leading community organizations to orchestrate the event. With the focus on health, the Chenango United Way was a leading community organization in the mission, responsible for volunteer training and recruitment. As the CUW intern designated for this project, I sat on the IRT planning committee that was responsible for the planning, logistics, and operations sections, budgeting, and volunteer orientation.

This specific mission was called the Greater Chenango Cares IRT mission and took place at the Norwich High School on July 13-22 as clinic with free medical, dental, optical, and veterinary services. Some of the services provided at IRT included: risk assessment for diabetes and high blood pressure, nutrition counseling and pain management, testing for cataracts, glaucoma, and macular degeneration, and spaying and neutering for animals.

Throughout the clinic, data was collected using a 27-question survey. The purpose of this survey was to assess community needs regarding transportation, homelessness, and healthcare coverage, in order to ensure better programming and events that best address identified needs. All information provided in the surveys was anonymous and remained confidential. The data was analyzed and mapped using geographic information systems (GIS).

Altogether, the Greater Chenango Cares IRT mission provided over $1.4 million to approximately 2,500 residents in Chenango County, with the help of over 300 volunteers.


Army and Navy service members provide optical (left), dental (center), and medical (right) services at the Greater Chenango Cares IRT mission.
Research Fellow: Nicholas “Nick” Didio (2016)                      Concentration: Astronomy/Physics

Faculty Mentor: Thomas Balonek                                 Department: Physics and Astronomy

Title of Project: Optical Variability of the Blazar 3C 454.3

Project Summary:

Over the course of the summer, my fellow research students and I monitored the optical brightness of the blazar 3C 454.3. A quasar is a distant galaxy with a supermassive black hole at its center. A blazar is a more ‘compact’ version of a quasar, and so the energy released by it is the largest of almost any object in the known universe. 3C 454.3 is one of these objects. At approximately eight billion light years away, 3C 454.3 is one of the most distant objects we can see with our telescope. It is believed that accretion of material onto this black hole drives the release of massive amounts of energy. We monitor from the Colgate Foggy Bottom Observatory’s 16-inch telescope over the course of the summer. The graph below highlights one of the characteristics of the object that we continually study. On the x-axis is magnitude, which measures brightness, and on the y-axis is color. We see from the graph that as the object gets brighter (points on the left are brighter), it also gets redder. Colgate’s data spans from the year 1989 to the present day. We also created a historic light curve, incorporating data from others as far back as 1899 and added this to the Colgate dataset that began in 1988. This expanded light curve will allow us to better understand the source, as we now have data from nearly 90 years prior that we did not have previously.

![Graph](image)

**Figure:** The optical color index of the blazar 3C 454.3 varies with its brightness (magnitude).

Title of Project: Digital 3D Model of the Colgate Campus for Bicentennial Project

Project Summary:

The Colgate Bicentennial Project is a directive headed by Professor Robert McVaugh and Joe Eakin for the creation of a visual exhibit that showcases the Colgate campus across two centuries. Students Mark Ma, Michael DiGiorgio, and Derek Sherry were assigned three of Colgate’s oldest buildings: Alumni Hall, East Hall, and West Hall respectively. Research for this project was done in the Colgate archives, where students guided by Professor McVaugh accessed building blueprints and sketches from their original architects. Then, they would use this data to construct digital 3D models of the buildings using modelling software. There were many hurdles to overcome along the way.

We originally planned on creating the present and past models of all three buildings. Students first worked on the present day incarnations of their buildings, intending to work backward in time. Present-day models of Alumni Hall, West Hall, and East Hall were created with real-world textures collected through high resolution photographs and contemporary records. However, time constraints forced us to focus on West Hall as the main focus of the historical presentation.

Many of the buildings have changed drastically from 200 years ago to now. To better understand the changes made, students had to access the blueprints of each building for each successive renovation done. For example, Alumni Hall’s interior was completely redone and the entire layout of West Hall’s dormitories has changed dramatically. These are just some examples of the massive changes that Colgate’s buildings have undergone through the years.

On top of scouring and discovering this buried information, students then converted the data into workable units (Imperial to Metric) for input into a computer modeling program called Autodesk Maya. Photographs, architectural sketches, and some artistic liberties were taken in reconstructing West Hall from the ground-up. First, the converted measurements, architectural blueprints, and historical photographs were used to create the general shape of each building such as shape, size, window placement, etc. Then, specific photographs are used for reference to create the unmeasured features of the building’s exterior such as railings, doorway designs, and window sills. Insight into the styles of the era were provided by Professor McVaugh to better recreate some finer details in the models that could not be found in photographs.

Our end product is three realistic computer models of Alumni Hall, West Hall, and East Hall as they look today and a fly-through rendering of a historically reconstructed West Hall, complete with its 19th century interior, derived from photographs and records found at the Colgate archives.

Title of Project: Identification of single-nucleotide polymorphisms associated with dog body size

Dogs exhibit numerous physical differences between breeds, yet they are highly similar within breeds due to the practice of selective breeding. Six genes have previously been shown to explain most body size differences between breeds. Interestingly, body size for individuals within the poodle breed can vary even for dogs that are the same at these six genes, suggesting that there are additional variants not identified.

In order to locate a chromosomal loci highly associated with body size, a quantitative genome wide association study (GWAS) was done last fall. We identified and sequenced chromosomal regions with a statistically high likelihood of containing body size-determining genes in poodles of different heights. The sequencing process determines the precise order of nucleotides, of which DNA between different poodles are compared and analyzed for single-nucleotide polymorphisms (SNPs) likely associated with body size. Regions with statistically significant SNPs were further analyzed, and candidate genes associated to dog body size were identified through comparison to the existing dog genome sequence for seven chromosomes (Table 1). Most regions contained genes that had previously been linked to body size, growth or body mass in other species.

Table 1. Chromosomal loci with the highest \(-\log(P)\) values contain candidate genes for dog body size-determination

<table>
<thead>
<tr>
<th>Chromosomal position</th>
<th>Highest (-\log(p)) p-value (iSNPs)</th>
<th>Possible Candidate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chr1:514</td>
<td>16.8 (5)</td>
<td>LCORL, FGFR1, ANAPC13*</td>
</tr>
<tr>
<td>Chr1:534</td>
<td>11.0 (12)</td>
<td>Unknown</td>
</tr>
<tr>
<td>Chr17:22</td>
<td>100.0 (3)</td>
<td>ALMS1</td>
</tr>
<tr>
<td>Chr2:72</td>
<td>9.4 (3)</td>
<td>ALMS1</td>
</tr>
<tr>
<td>Chr3:28</td>
<td>9.1 (7)</td>
<td>N.d.</td>
</tr>
<tr>
<td>Chr21:41</td>
<td>9.1 (4)</td>
<td>PTEN<strong>_SOX6</strong></td>
</tr>
<tr>
<td>Chr9:44</td>
<td>9.0 (4)</td>
<td>OH. MAFAK3*</td>
</tr>
</tbody>
</table>

Table 2. Summary of significant variants detected in candidate genes that may be responsible for differences in dog body sizes

<table>
<thead>
<tr>
<th>Gene</th>
<th>Location</th>
<th>SNP</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>ALMS1</td>
<td>Exon 7</td>
<td>A/G</td>
<td>Change from Asparagine to Glutamic Acid (ag. charged)</td>
</tr>
<tr>
<td>ALMS1</td>
<td>Exon 7</td>
<td>A/G</td>
<td>change in a region of the important region</td>
</tr>
<tr>
<td>ANAPC13</td>
<td>Exon 1</td>
<td>C/G</td>
<td>SNP causes preterm skipping to promote skipping region</td>
</tr>
<tr>
<td>FBR1</td>
<td>Exon 3</td>
<td>C/T</td>
<td>SNP causes preterm skipping to promote skipping region</td>
</tr>
<tr>
<td>FBR1</td>
<td>Exon 3</td>
<td>C/T</td>
<td>SNP causes preterm skipping to promote skipping region</td>
</tr>
<tr>
<td>SOX6</td>
<td>Exon 5</td>
<td>G/C</td>
<td>Change Scoring (charged) to uncharged (pos. uncharged)</td>
</tr>
<tr>
<td>SOX6</td>
<td>Exon 5</td>
<td>G/C</td>
<td>change in a region of the important region</td>
</tr>
<tr>
<td>FBR1</td>
<td>Exon 3</td>
<td>C/T</td>
<td>SNP causes preterm skipping to promote skipping region</td>
</tr>
<tr>
<td>FGFR1</td>
<td>Exon 7</td>
<td>T/C</td>
<td>SNP causes preterm skipping to promote skipping region</td>
</tr>
</tbody>
</table>

After fine-mapping the candidate genes on chromosomes 3, 17, 2 and 21, potentially causative SNPs were identified on ALMS1, ANAPC13, PTH, and SOX6 (Table 2). Some of these SNPs were predicted to potentially have a negative effect on the expression or function of that gene. Because it affects the amino acid sequence, we found the ALMS1 SNP the most suggestive. We genotyped thirty-five dogs for which we had information on their genotype for the six genes that are responsible for between breed size variation. The data set including the ALMS1 SNP had an R² value of 0.545 (p<0.001), while the data set without the ALMS1 SNP had an R² value of 0.231 (p=0.172) (Fig. 5). The results suggest that the ALMS1 SNP on exon 7 significantly accounts for the variation in dog body size.

Fig. 5. ALMS1 exon 7 coding region SNP increases predicted dog body size.

In conclusion, variants in the genes LCORL, FGFR1, FABP, PTH, SOX6, ANAPC13 were successfully identified. The ALMS1 SNP on exon 7 is very promising, and will be sequenced in more poodles to better understand the significance. Larger sample sizes and DNA from different dog breeds will supplement the analysis of identified SNPs. Future research includes finishing the sequencing of FGFR1, SOX6, ALMS1, and ANAPC13. We also plan to collaborate with the NIH to obtain DNA sequences for the chromosomal loci of interest, in hopes of further identifying additional SNPs.

Faculty Mentor: Anthony Chianese  Department: Chemistry

Title of Project: Iron Catalyst Synthesis and Catalytic Reactions

Project Summary:

In the search for new catalysts to aid reactions, I have taken a specific approach by focusing on the use of iron. Iron is abundant and not toxic, unlike metals that are currently used in successful catalysts, like ruthenium. The iron solution decomposed in the presence of oxygen so most of my work was done in the glove box, creating the problem of how to isolate an air sensitive solid. To do this, I used a layering technique to obtain crystals of the product, which I then utilized in several catalytic reactions.

I worked for the majority of the summer on the most efficient way to obtain my product – specifically, the FeCNN-DEA catalyst. The figure below shows the process of metalation of the CNN-DEA ligand to obtain the desired product. This is generally the same procedure as that for the parallel ruthenium catalyst.

Once in solution, I attempted a variety of methods for isolating the crystals. In the end, the path that worked the best involved adding pentane to the iron solution to obtain an orange precipitate, dissolving this precipitate in dichloromethane, and then layering with pentane. Large, red crystals were desired. They could be identified from their x-ray crystal structure, as H-NMR spectra were difficult to decipher due to the paramagnetic nature of the iron complex. In making the product, I also experimented with the amount of ligand and solvent used.

Toward the end of the summer, enough crystals were made to begin testing them in catalytic trials. I focused on hydrogenation and hydroisilylation reactions. The hydroisilylations seemed to be successful, specifically ketone and ester hydroisilylations. The amount and variation of substrate was altered in the experiments and the products were identified using mass spectroscopy and peaks from the H-NMR spectra.

Research Fellow: Rachel Drucker (2017)  Concentration: Educational Studies
Faculty Mentor: Mark Stern  Department: Educational Studies

Title of Project: Notes on a Feminist Reading of Education Policy

Project Summary:

Professor Mark Stern’s summer research project culminated his work in Philadelphia during the Fall 2014 semester. During that time, he interviewed a variety of individuals who are involved in the Philadelphia public school system, including teachers, activists, and counselors. Through these in-depth interviews, he aimed to evaluate the top-down procedures that many teachers face, such as merit-based pay, and the ways in which teachers are increasingly devalued and overworked. Because the teaching force is made up of predominantly women, whereas educational policymakers and administrators are predominantly men, Professor Stern argues that educational policy is oftentimes a form of structural violence against women. Furthermore, he evaluates the ways in which teachers involved in educational activism embody feminist principles of love and care, whether or not they explicitly label these activist groups as feminist.

Professor Stern presented these feminist theories to me, but he allowed me the agency to generate questions and thoughts on my own. I was privileged to have an advisor who granted me agency in this research. I transcribed each of the interviews and then coded them, making note of discussions of “top-down policy as patriarchal” and “teacher activism as feminist.” In addition, I read multiple books and essays about the feminization of teaching. Professor Stern and I met multiple times to engage in conversation about the research and exchange ideas, which helped me understand the complex process of data analysis. With Professor Stern’s advice in mind, I approached the interviews with a feminist lens. I became increasingly interested in female activists’ ability to embody armed love in ways that men, stifled by masculinity, are often unable to do. I recognized the tendency of teachers to attribute their desire to continue teaching to love, which is a unique anti-capitalist tendency that most Americans in the work force do not possess. With Professor Stern’s theories in mind, I learned that professions such as teaching are often devalued precisely because of these principles of care and love. Emotions, typically attributed to women, are seen as “unproductive” in capitalist society.

As I transcribed interviews of various educators and compiled photographs of abandoned Philadelphia schools, I slowly began to understand Professor Stern’s initial theories. The interviews clearly reinforced the notion that policymakers enact structural violence upon the predominantly female teaching force. Patriarchal structures perpetuate this inequity. Many of the interviewees agreed with this prospect, but admitted that they had not explicitly recognized this before. Like many other systems of oppression, violence against teachers is insidious but invisible. This research project generated questions for me about educational activism and feminist theories of resistance that I hope to continue to explore in the future.

Title of Project:  Diatom Flux in Salmon Bay, Ross Sea, Antarctica and Diatom Variation at Larsen A Embayment, Antarctic Peninsula

Project Summary:

With the rapid changes occurring in global climate today, there has been clear evidence of its impacts in the Antarctic. Loss of glacial and sea ice has become increasingly common, with marked effects on marine ecosystems. This summer, I analyzed marine surface sediment samples from Salmon Bay, a location in southwestern McMurdo Sound, Ross Sea, where perennial of sea ice broke out in 2011. Replacement of thick perennial sea ice with much thinner annual ice allowed sufficient light penetration for sub-ice photosynthesis to occur, resulting in the occurrence of a very unusual sub-ice community of diatoms hanging beneath the ice in algal strands. Divers collected samples from the ocean floor containing this diatomaceous material. From the Salmon Bay samples, I dried the sediments and prepared them into slides to be viewed under the microscope at a magnification of 1000x. I then photographed and began classification of each diatom species present in the samples. These images were then compiled into a handout for Professor Leventer’s presentation at the Polar Marine Diatom workshop, held every two summers. These data are important because they provide a window into understanding the kinds of communities that may develop as temperatures warm, and ice cover diminishes.

This summer, I also collaborated with one of my peers, Aurelia Casarrubias, to analyze the varying diatom populations in sediments collected from four megacores at the site of the Larsen A ice shelf before and after its disintegration. These sediments were analyzed in one centimeter increments with a minimum of 400 specimens identified and tallied on each slide. The data for 10 centimeters of each megacore was then graphed to show the variation of the three predominant diatom genera (Fragilariopsis, Thalassiosira, and Chaetoceros) as well as total diatom abundance. These data documented a large increase in absolute diatom abundance following ice shelf disintegration.

☒ Other (specify):  Hackett-Rathmell 1968 Memorial Fund
Research Fellow: Nhien “John” Duong (2017)  
Concentration: Mathematical Economics

Faculty Mentor: Quang “Mike” Shen  
Department: Chemistry

Title of Project: Geometry from electron diffraction radial distribution curve

Project Summary:

Our objectives in the summer are to identify the most suitable geometry for different molecules using the graph obtained from experimental electron diffraction. I was given the task of identify the geometry for a few molecules, one of which is 2,2 di-Me-1,3 dioxan 5 one.

For this molecule, three models were tested, chair, boat and twist model. Boat form was quickly rejected due to the high energy from ab initio calculation (by freezing coordinates) and its RD plot which deviates very far from experimental. Chair and Twist forms were results from energy optimization calculated by Gaussian. Twist form seems to be the best model, with the smallest least squared R: 0.0357. The plot of a theoretical RD curve closely matches the experimental curve obtained from electron diffraction. This theoretical result is obtained after the refinement of all important bond lengths and angles and a few amplitudes. All the bond lengths appear to converge at values that are very close to ab initio value calculated using Gaussian. For example, C-C bonds after refinement, stay consistent, vary from 1.5210 to 1.5205. On the other hand, the chair form does not seem to fit the experimental result well. The least squares R value to 0.255 which is a lot bigger than 0.0357. The bond lengths seem to be fine (with RIJ values between 1 and 2), not very far off from experimental values. However, the distance between 2 atoms that are not bonded is very off (RIJ between 3 and 5), indicating that the angles and dihedral angles are inaccurate. Looking closely, the difference between chair form of the molecule and twist form of the molecule lies at the angles and dihedral angles and not the bond distance. Hence, it seems reasonable to suggest that the twist model of the molecule illustrates the most probable form of the molecule.

Source of Support:  
☐ AHUM Div.  ☑ NASC Div.  ☐ SOSC Div.  ☐ UNST Div.  
☐ Other (specify):
Research Fellow: Ishir Dutta (2017)  
Concentration: Physics

Faculty Mentor(s): Enrique “Kiko” Galvez
Joshua Jones

Department: Physics and Astronomy
Department: Physics and Astronomy

Title of Project: Discriminatory Forces on Chiral Molecules

Project Summary:

In recent years there has been increased interest in a novel optical force that affects chiral molecules distinctly. An object is said to be chiral when it may not be superimposed onto its mirror image. Classic examples include hands or molecules. Some common chiral molecules are tartaric acid and glyceraldehyde. The “handedness” of these molecules may be identified by the direction in which they rotate linearly polarized light. A major practical application of such a chirality-dependent force would be a new method to separate chiral molecules in a solution. This is particularly relevant to the manufacture of pharmaceuticals, as more than 50% of pharmaceutically active substances are known to be chiral. The objective of this project is to confirm the properties of this force in the lab by using a beam with a gradient of helicity to separate chiral molecules.

In 2014, Cameron, Barnett, and Yao proposed a force of the form $F = a\nabla E + b\nabla H$, where $E$ and $H$ are the local densities of electric energy and helicity, and $a$ and $b$ are constants that depend on the molecule. The helicity-dependent term of the force is discriminatory and may be used to separate the enantiomers.

In our experiment, we used a teal Poincaré ‘pump’ beam to exert the force, and we probed the sample using an interferometer. Two coherent, collinear beams that were right and left circularly polarized before entering the cell were interfered after emerging from the sample to detect any changes in the state of the solution. We experimented on BINOL and tartaric acid as our racemic solutions.

We observed that the fringes first squeezed together and then moved up or down, depending on the phase of the pump beam. However, there were additional intensity-related effects which had a significant influence on the interferometer readings. Future work may consider minimization of accessory effects by subtracting the signal produced by intensity and heating, or considering molecules with greater optical activity, such as helicenes.

Source of Support:  
- AHUM Div.  
- NASC Div.  
- SOSC Div.  
- UNST Div.  
- Other (specify): Justus ’43 and Jayne Schlichting Student Research Fund
Project Summary:

There has been significant growing research that indicates consumers do not respond to discounts as traditional economic theory predicted they would. The law of demand predicts consumers should choose a discount that minimizes expenditure. This line of thinking also suggests that consumers should be indifferent between a sale and an equivalent reduction in price, such as a rebate or the removal of a state sales tax, as long as the final purchase price is identical. As economists begin to analyze what consumers actually do instead of what they should do, we find that the framing of a discount significantly alters consumers’ responsiveness.

In this study we use a natural experiment in a small business to analyze consumer’s responses to different framing of discounts. Many of the explanations for this behavior stem from previous literature that has explored the effects of price frames, consumer price knowledge, and how the salience of prices affects consumer demand. Most importantly, though, the study attempts to add to the accumulating research concerning the effect of the framing of a discount on consumer purchasing patterns.

We analyzed data from a local, multi-store company in Massachusetts specializing in young children’s toys and baby gear. The data is from the summer encompassing two separate time frames: Massachusetts annual Tax-Free Weekend (TFW) and the company’s date of founding when they offer a 7% sale off all items in the store (henceforth referred to as BDAY). We use transaction-level data for every day in the months of June to August for the years of 2008-2014 across 6 different store locations. Over this seven-year period, Massachusetts held Tax-Free Weekends (Sales Tax Holidays) in all years except 2009. The state’s sales tax during these years was 6.25% except in 2008 when it was 5%. We test for differences in consumers’ demand on Tax Free Weekend, the store’s Anniversary Sale day to demand on similar days during the summer. On Tax Free weekend, consumers pay the ticket price, while on the Anniversary sale consumers obtain a 7% discount over the ticket price, which is then used to compute the sales tax, which is then added to the discounted price. The resulting difference in the effective price consumers pay is 1.18%, which makes the comparison between the two types of discounts a plausible test of discount framing on demand. According to the law of demand, consumers’ average expenditure on the Anniversary Sale day will be larger relative to average expenditure on Tax Free Weekend. However, consumers spending more money on average on Tax Free Weekend suggests the advertising makes the absence of the sales tax salient. In the rest of the paper we explore the implications of this research on taxation policy, specifically focusing on the importance of sales taxes.

Research Fellow: Fiona Evans (2016)  
Concentration: Chemistry  
Faculty Mentor: Jason Keith  
Department: Chemistry  
Title of Project: The Effect of Grignard Reagents in the Addition of Acyl Groups  

Project Summary:  

Porphyrsins and porphyrinoids are an important category of molecules in biological systems. These molecules contain a system of four rings and can have a number of different substituents around the outside of the system. Porphyrin systems are important because they can serve as ion transporters in living systems, like the porphyrin incorporated in the hemoglobin protein of blood cells. This porphyrin binds to iron, which is essential for human life. Dr. Rick Geier studies the synthesis of porphyrinoids and specifically attempted to make N-confused corrole. The reaction scheme was to add two chloroacyl groups to a bipyrrole system to make a symmetric bipyrrole product. However, the synthetic process did not work to produce the expected intermediates. My research focused on theoretical modeling of this reaction using the computer program Gaussian 09. The first step in the research was to calculate the theoretical energies of all reactants, intermediates and products. The next step was to find the mechanism of the reaction by finding the transition states of the two reaction steps. An energy profile was outlined for the expected and observed reactions using the calculated energies for the different steps in the reaction. The energy profile for the reactions indicate that the presence of magnesium bromide, a Grignard reagent, likely caused a lowering of the transition state energy, resulting in the observed product.

In the first step of the project, all possible isomers of the bipyrrole reactants and products were considered and the energy of each was calculated. This includes the number of acyl substituents (one or two) on the system, the positions of these acyl substituents and if the nitrogen atoms were bound to a hydrogen, magnesium bromide, or had a negative charge. These energy calculations could not confirm the expected product or explain the observed product, indicating that kinetics are likely the controlling factor in the reaction. The transition states for the lowest energy species were found for the first and second addition of the acyl group. For the first addition, the presence of the magnesium lowers the energy of the transition state by about 10 KJ/mol. For the second addition, the presence of magnesium bromide seems to have a directing effect on the acyl group. Final transition state energy calculations are still being run to determine how much the presence of the Grignard reagent changes the transition state energy. Theoretical nuclear magnetic resonance calculations were performed on the expected and observed products, but could not provide conclusive information about which is present. All calculations were performed in Gaussian 09 using a 6-311+G** basis set and a B3LYP functional.

![Expected final product](image1) ![Observed final product](image2)

**Source of Support:**  
- [ ] AHUM Div.  
- [x] NASC Div.  
- [ ] SOSC Div.  
- [ ] UNST Div.  
- [ ] Other (specify):
Title of Project: Coping with Nuclear Decommissioning Shocks in Local Communities in the U.S.: Case studies of Haddam, Connecticut and Wiscasset, Maine

Project Summary:

There are currently over 100 nuclear reactors throughout the United States. As nuclear plants age and anti-nuclear sentiment intensifies, many reactors are set to close in the coming years. Nuclear plants have been constructed in mostly rural, isolated communities, and they often constitute the primary source of employment and tax revenue for these towns. Our research focused on the economic and social effects of nuclear decommissioning on communities in the United States. This work ultimately connects with Professor Yamamoto’s broader international research concerning how nuclear decommissioning will affect societies in the future, particularly in Japan, where nuclear power is an especially prominent societal issue. The two towns studied were Haddam, Connecticut, and Wiscasset, Maine. Both towns had nuclear plants decommissioned between 1996 to around 2006, yet exhibit varied results from this process.

This summer, we conducted extensive fieldwork, which consisted of on-site observations and interviews with local stakeholders, including local politicians, business owners, community leaders, and residents. We stayed in each community for approximately two weeks, and spent our remaining weeks transcribing the 40-50 interviews that we conducted over the course of the work. Community members were generally very willing to speak with us about their experiences, and provided ample information about both the town and the general feelings towards the nuclear sites. Haddam saw a mixed response: while some local residents are struggling to cope with higher tax rates since the loss of the plant, others have largely accepted the loss of the plant, and are working to maintain Haddam’s traditional community atmosphere in spite of this challenge. The population continues to increase, the school system remains excellent, and the general state of the town is not too dissimilar to what it was before plant closure. The largest issue still facing the residents of Haddam is the evaluation of the spent fuel site, where the radioactive fuel from the former plant it still being stored. Given that nuclear decommissioning is a relatively recent issue, there is no pre-determined “fair value” for a spent fuel storage site, and the town and the utility company are still debating the value of property taxes that should be owed to the town.

The impact of the loss of the plant in Wiscasset was much more visible. Unlike Haddam, which generally put tax revenue from Connecticut Yankee towards keeping tax rates low, Wiscasset embraced the plant more fully, using tax revenue to pay for an expanded school system and high quality public services, facilities, and infrastructure. Residents discussed a spike in taxes, a clear drop in the quality of the school system, a big change in demographics, and cuts to municipal programs and infrastructure as a result of the loss of the plant. Overall, we determined that the impact of the loss of a key economic source, such as a nuclear plant, is not a black and white issue: it depends on community conditions and context, local politics and economics, and many other issues. Local uniqueness and variation play a big role in determining economic impacts. Taxes were overall the largest issue across both towns; communities facing a similar challenge in the future should seek to prepare for this, either through reserve accounts, budget cuts, or other mechanisms to minimize the shock to the local community that will most likely occur.
Research Fellow: Valeria Felix (2018)  
Concentration: Sociology

Faculty Mentor: Julie Dudrick  
Department: Upstate Institute

Title of Project: Field School Fellow with the National Abolition Hall of Fame and Museum

Project Summary:

Over the summer, I held a fellowship with the National Abolition Hall of Fame and Museum in Peterboro, NY through Colgate University’s Upstate Institute program. Upstate Institute Summer Field School matches Colgate students with nearby organizations in order to benefit regional communities. Students are matched based on their skills and interests with organizations that are looking for such candidates. Such fellowships last a duration of 8-10 weeks. My fellowship was with a non for profit organization which strives to honor anti-slavery abolitionists and works toward the moral conviction to end racism.

Throughout the duration of my fellowship, I had to become well informed and comfortable with the history of slavery and abolitionism in the United States. One of my biggest tasks and contributions to the National Abolition Hall of Fame and Museum (NAHOF) was my duty of hosting. I learned about the history of the building, the town, and became aware of everything’s location. Whenever guests visited, I greeted them and gave them a tour of the space while answering any of their questions. I learned that even though Peterboro, NY is a hamlet in such a small town, it was filled with so much influence in the strides against slavery.

Aside from my daily task of hosting, I had various projects throughout my weeks at NAHOF. In particular, one of my projects was completing an entrance query analysis to track marketing for the 23rd Annual Peterboro Civil War Weekend. Civil War Weekend is an educational and philanthropic fundraising event for which funds are allocated towards the preservation and restoration of historical sites such as NAHOF. Many people come together during this event dressed as re-enactors of the 1800s and either participate in or view a skirmish between Confederate and Union soldiers. I asked a majority of guests upon their arrival basic personal information such as zip code and how they had become aware of Civil War Weekend. I grouped their responses in a variety of categories such as newspapers, television, or plywood signs. After gathering all of the data, I analyzed differences in responses amongst returning guests and first-time guests and the best locations for advertisement signs. With the data I gathered and my detailed write-up, I helped the organization have a better understanding of where marketing funds should be allocated for the upcoming Civil War Weekend.

My overarching project for NAHOF involved the Inductee Class of 2016 to the Hall of Fame. I worked on contact spreadsheets, induction and commemoration documents, and inductee biographies. I did some research on each of the four inductees and their commitment to anti-slavery abolitionism. By doing so, I assisted with preparing for their Induction Ceremony and Commemoration Ceremony in the coming years.

With my work as an Upstate Institute Fellow, I was able to improve my skills with different technological systems and learn about Central New York’s role in the anti-slavery movement all while helping out a local non for profit organization.

☒ Other (specify): Upstate Institute
Title of Project: Investigation of a One-Flask Synthesis of an N-Confused Porphyrin Bearing Pentafluorophenyl Substituents

Project Summary:

Porphyrinic macrocycles with altered core structures are of interest. Structural alterations of particular note include a direct bipyrrrole linkage, the number of core NH groups, and the location of the nitrogen atoms. Among a variety of porphyrinoids, porphyrin, corrole, and N-confused porphyrin are of current interest to our research group. To study these compounds, convenient methodology for their preparation is needed. Over the past two years, we have been exploring a one-flask synthesis of an N-confused porphyrin (NCP) bearing pentafluorophenyl substituents. This is an interesting synthesis to investigate as reaction conditions that afford tetraphenyl NCP in a yield of 39% were reported to work poorly (yield of <0.1%) when applied to the preparation of the pentafluorophenyl substituted N-confused porphyrin (C₆F₅-NCP).

Previously, a sample of C₆F₅-NCP was prepared and used to develop an HPLC method for monitoring analytical-scale reactions and initial analytical-scale reactions were performed (Tori Kensy ’14). Last summer, we completed an expanded analytical-scale investigation of the one-flask synthesis of C₆F₅-NCP. Five different acid catalysts at a variety of concentrations, reaction times, and oxidant quantity were surveyed. Reaction conditions were identified that afforded C₆F₅-NCP in a yield of ~10%.

This summer, we sought to confirm key findings from the prior analytical-scale study by carrying-out reactions on a preparative-scale. Three reaction conditions were selected based on the yields of C₆F₅-NCP and the other porphyrinoid byproducts. The most promising condition was performed three times to assess reproducibility. The best condition identified from our analytical-scale study consistently afforded C₆F₅-NCP in the expected yield. Purification of the C₆F₅-NCP by column chromatography and crystallization was straightforward. Preparative-scale reactions using the other two reaction conditions provided yields of C₆F₅-NCP and the other porphyrinoids largely in agreement with prior analytical-scale findings. However, one condition gave a complex product mixture that complicated purification. Overall, approximately 1 g of C₆F₅-NCP was obtained from our preparative-scale reactions. Thus, a one-flask synthesis of C₆F₅-NCP from commercially available starting materials can be an effective approach for the preparation of this porphyrinoid.

☒ Other (specify): Arthur G. Chase Science Fund
Research Fellow: Sean Foster (2016)  
Concentration: Physics

Faculty Mentor: Jonathan Levine  
Department: Physics and Astronomy; Pre-Engineering

Title of Project: Mineral Identification Using a Prototype Spaceflight Mass Spectrometer

Project Summary:

This summer, I conducted research in Colgate’s Physics department with Professor Levine. Working with two researchers at the Southwest Research Institute in Boulder, Co, we are trying to develop a spaceflight mass spectrometer, capable of dating rocks on other planetary bodies. Presently, we have a proposal submitted to NASA to send our spacecraft to the moon. Current age estimates on the moon, and elsewhere in the solar system, are based on crater densities, but these estimates yield imprecise ages with uncertainties as great as one billion years. Our instrument would be able to constrain ages to a much lower uncertainty, thus giving us a more complete chronology of the events that have taken place on the moon. Understanding this chronology is vital for understanding the physical processes that are at work not just on the moon, but on all planetary bodies.

We use the $^{87}\text{Rb}^{87}\text{Sr}$ isochron method to infer the time since the rock formed. To measure elemental and isotopic abundances of rubidium and strontium, we employ the technique of resonance ionization, which involves a number of lasers. We first use an ablation laser to liberate atoms from the surface of our samples; we then use lasers tuned to specific wavelengths to electronically excite resonances in rubidium and strontium; and finally, we use a laser to ionize the excited atoms. We then send the ions through a time of flight mass spectrometer towards our detector, which produces a voltage proportional to the number of ions that hits it. Since ions of different mass will hit the detector at different times, by looking at the spectra we can distinguish ions of different masses. From these spectra, we can calculate the elemental and isotopic abundances of rubidium and strontium, from which we can infer an age.

In this experiment, we are posed with a number of challenges. One such challenge is mineral identification; we wish to know, for each spot analysis, what mineral are the lasers hitting. Mineral identification is critical for interpreting the ages that we calculate since samples may have undergone complicated thermal histories that could act to reset the abundance ratios within the rock. To perform this mineral identification, we obtain spectra, for each spot analysis, of the ions liberated from the sample by the ablation laser only. This amounts to turning off the resonance and ionization lasers, which are specific to measuring rubidium and strontium. We can infer which spots are the same mineral because spots of similar composition should produce similar ions when struck by the ablation laser, thus giving us similar spectra.

To analyze this data, I have developed an analytical tool in MATLAB that can look at various statistical measures for each spot’s spectra to see if any natural groupings emerge. One such statistic that we have looked at is the mean, or average, mass of each spectra. By looking at the location of the spots on the sample in conjunction with our statistical measure, we are able to identify groups, which could correspond to the same mineral. I will be continuing this work in the fall, and we plan to find new statistical measures, like the mean-mass one, that reveal meaningful groupings, so that we can confidently identify minerals. With this information, we will be able to better interpret each point on our isochron and be more confident in the ages that we determine.

Source of Support: 
☐ AHUM Div.  ☒ NASC Div.  ☐ SOSC Div.  ☐ UNST Div.  
☐ Other (specify):
As a first-time Upstate Institute Summer Field School Fellow, I was fortunate to have the opportunity to work in an environment into which I will be entering quite soon. The Madison County Department of Health (MCDOH), located in the quaint village of Wampsville, is divided into four divisions that ultimately work together in order to improve the health of Madison County: Administration, Preventative Health, Environmental Health, and Children with Special Health Care Needs. Since I am beginning my Master of Public Health degree with a concentration in Maternal and Child Health this Fall, it was most appropriate for me to utilize my skills and my interests within the Preventative Health division. I worked directly under the Director of said division, Cheryl Geiler, on a project that required both research and organizational skills. Upon starting my work, I received a box filled with hundreds of files, each containing data specific to a mother or child from whom a Registered Nurse (RN) had collected data within roughly the past two years. My first task was to enter each piece of handwritten information into Microsoft Excel spreadsheets so that the MCDOH could access and record its data more efficiently. In addition to recording the data electronically, I categorized spreadsheets and patient information in a manner that would make it easier to locate in the future. After finishing this portion of my project, I turned towards the research side of the work in two specific areas: lead risk in the home, and breastfeeding. For the former subject, I analyzed responses to a lead questionnaire that patients had completed in order to pinpoint locations in Madison that could possibly house lead (through paint, dust, parental occupation, etc.) and, therefore, be threatening environments for babies and pregnant women. For the latter topic, the goal was to extract information that would encourage expecting and new mothers in Madison to breastfeed. I graphed the methods of feeding that mothers reported as currently providing for their babies (feeding with only breast milk via breast and/or bottle, feeding with both breast milk and formula, or feeding with only formula). Additionally, I analyzed and graphed changing weights of the observed infants. Both pieces of information displayed that most babies that the MCDOH has observed in this time period are receiving formula, yet babies who receive breast milk display greater weight gains over time, which is a promising piece of information.

In both research portions of the project, however, I had to be wary in making concrete conclusions or insinuating causation. For instance, the majority of the data yields from mothers and children in either Canastota or Oneida, which can presumably be explained by the proximity of the MCDOH to both areas. Thus, it is important to note that more cases from a greater variety of locations are required before true statistical analyses can be conducted with respect to either lead risk or breastfeeding. Another obstacle was that I sometimes had to fill missing pieces of information to the best of my ability, which also could have skewed results. Moreover, the method by which the MCDOH currently collects its Maternal and Child Health data is in need of a tune-up. By making questions more specific, both in terms of content and the answer choices provided, one can attempt to determine if specific characteristics of mothers and babies (type of home, socioeconomic status, etc.) are correlated with the possible lead hazard presented by the home in which they live, or with the type of feeding that the mother provides for her child. Nevertheless, I believe that I successfully completed work that will ultimately help the Preventative Health division. By using GIS (courtesy of the other Summer Field School Fellow working at the MCDOH, Kayleigh Bhangdia), one can now find which homes are currently considered “risky” in terms of lead presence, and can attend to the home’s need accordingly. With the feeding findings, it is incredibly beneficial to find that the babies receiving breast milk are, on average, gaining more weight compared with babies receiving both breast milk and formula, or only formula (yet one must still be cautious as certain babies—“preemies”—could be skewing data). The goal of the Healthy Start Partnership (whose members come from the MCDOH and other local organizations) is to promote positive health habits in mothers and babies, and encouraging mothers to breastfeed is one of its many long-term projects as a result of its benefits for both parties. As weight gain in infants is a sign of healthy growth, this information will hopefully prove useful for the Partnership and for mothers and babies in the long-term.

Source of Support:  
☐ AHUM Div.  ☐ NASC Div.  ☐ SOSC Div.  ☐ UNST Div.  ☑ Other (specify): Upstate Institute
Research Fellow: Usman Ghani (2016)  
Concentration(s): Physics; Biochemistry

Faculty Mentor: Rebecca Metzler  
Department: Physics and Astronomy

Title of Project: Correlating impurity concentration and crystal orientation to the fracture radius in Barnacle shells

Project Summary:

Barnacles are ancient arthropods that produce a mineralized exoskeleton for protection. For the first part of my research, I worked on investigating the relationship between the strength of different parts of the barnacle exoskeleton and the concentration of impurities in the shell. The impurities in the exoskeleton were measured by grinding samples and analyzing them with infra-red spectroscopy at successive grindings. The graph obtained from with infra-red spectroscopy displayed two peaks whose heights changed with each successive grinding. The heights were then plotted and the gradient was obtained. This was a measure of the atomic disorder of the crystals in the shell and thus was also an indicator of the concentration of impurities present in the shell.

In order to examine the strength of the exoskeleton, we examined the fracture radius of the samples. The samples were mounted in epoxy and indented using a micro indenter. The radii of the fractures were then measured using a microscope. The average radius of the fractures was then compared to the impurity concentration of the shell corresponding shell. From the samples used, no correlation was observed between fracture radius and impurity concentration.

For the next part of my research, the crystal orientation of the shells was measured using a scanning electron microscope and electron backscatter diffraction (EBSD). The crystal orientation could be detected for some samples but not for all of them. For this reason, the crystal orientation and the fracture radius could not be compared using this method.

Source of Support:  
☑ AHUM Div.  ☑ NASC Div.  ☐ SOSC Div.  ☐ UNST Div.

☐ Other (specify):
Title of Project: Field School Fellow with Oneida County Historical Society

Project Summary:

I conducted research with the Oneida County Historical Society this summer as a part of the Upstate Institute Summer Field School. I helped with their social media platforms - mainly their blog site and twitter account. I also assisted in the organization of both physical and digital archival materials. The main bulk of my work, though, was the creation of an exhibit on a topic of my choice for the main gallery of the historical society’s upstairs museum.

The processes of these projects are pretty cut and dry. For the social media portion, I reviewed how and what they were doing and how effective they were at reaching their audience. Their Facebook account is quite active for an organization of their size. That being said, I introduced the idea of possibly using Facebook ads to sponsor events, because it’s an easy and cheap way to get information to people. The twitter account was used to get in touch with the community on a broader level than Facebook. Using the account, I retweeted entities such as the Saranac Brewery or the Utica Boilermaker road race to get the historical society more integrated with the local area. We also informed followers of events held at the Historical Society through Twitter. Finally, the blog was something of a more creative outlet. I wrote on various buildings in the area to inform readers of their pasts.

The organization of archival material - both digital and physical - consisted of organizing pictures, postcard, and other artifacts, or naming and creating easy-to-identify folders for pictures that had been scanned on to the computer server.

Finally, in creating an exhibit I had to do a great deal of research. After I had gathered and reviewed enough information, I created a 6 display case exhibit centered around various sports - Olympic, basketball, baseball, etc. - in the Oneida County area. My exhibit should be on display at the Historical Society through next summer.

Research Fellow(s): Rachel Goldberg (2016) Concentration: Neuroscience
Catherine Walsh (2016) Concentration: Neuroscience
Yanchang “Lily” Zhang (2017) Concentration(s): Neuroscience; MAEC

Faculty Mentor: Bruce C. Hansen Department(s): Neuroscience; Psychology

Title of Project: Decoding Image Category with Electroencephalography (EEG)

Project Summary:
Throughout the summer, we assisted Professor Hansen in creating and executing a pilot study to determine if a relatively new technique called neural decoding would work with electroencephalography (EEG), a method of brain imaging that looks for changes in electrical potentials in a participant’s brain. In a prior study utilizing a different technique, Professor Hansen and his colleagues demonstrated the success of neural decoding, in which a computer model predicts what type of image a person is viewing solely from their brain activity. We first read background literature on how the brain represents visual imagery and the basics of neural decoding so that we could brainstorm ideas for our study with Professor Hansen. Once we determined the structure of our study, we located and edited images from 30 different categories. We then built our study using ePrime, a computer program commonly used in psychology and neuroscience research to present stimuli. After being trained on how to 1) apply EEG electrode nets correctly, 2) monitor subjects’ brain activity as they completed our task, and 3) analyze the data using both the data collection software and MATLAB, we began to run participants for our experiment. Finally, we analyzed the data from 10 subjects, each of whom completed two sessions, and determined that neural decoding is possible using EEG. As a result, Professor Hansen will continue using neural decoding with EEG in the fall to study the brain processes that are involved in scene categorization.

In our experiment, we had each participant view images for 500 ms while wearing an EEG electrode net and classify each image as urban, indoor, or natural. We chose not to analyze the classification accuracy at this time and instead focused on the participants’ neural activity as they saw each image. Professor Hansen guided us in writing MATLAB code to analyze this activity after each participant completed a session. Our code allowed us to create event related potentials (ERPs) to visualize each participant’s response for the average of all trials for each image category at particular electrodes. These ERPs indicated that different image categories yielded distinct temporal responses. To determine if our visual inspections were statistically significant, Professor Hansen ran an error correcting multi-class support vector machine analysis, in which a computer model would try to distinguish a given category as distinctly separate from all of the other categories combined together. This analysis allowed us to determine whether we could discern which image category a participant was viewing solely from the participant’s temporal brain activity. When we conducted this analysis using the entire waveform and a single electrode, we obtained an average accuracy of 84.1%; using both the entire net and the entire waveform, we obtained an average accuracy of 98%. Such a high accuracy suggests that decoding is indeed possible with EEG and will allow Professor Hansen to continue his work with decoding.

For his next step, Professor Hansen plans to look at decoding using the convolutional neural network (CNN) model, a model of the human visual system that involves numerous layers of processing based on both basic features of images, including spatial frequency and amplitude of the waves of light, and higher level cognitive representations. He will correlate the category of an image that the CNN predicts based on a person’s neural activity at different time points post stimulus onset with the errors that a person makes in categorizing an image, as well as the output of CNN. Such an analysis will test whether earlier layers of the CNN correlate with earlier ERP components and later layers of the CNN correlate with later ERP components.

□ Other (specify):
The population of immigrants in the United States has been increasing dramatically in the past few decades. This phenomenon has caused heated debate about how the immigrants have influenced the U.S. native workers for decades. The debate arises from two opposite arguments: immigration has lowered the wages for the native workers, versus immigration has insignificant to positive effects on the native wage structure. Both of these arguments are supported by various empirical analyses. Having two strong and opposite arguments about a topic of such political importance is disconcerting. Many economists attribute this disparity to the different methodologies adopted by the researchers on the opposite sides. The two methodologies that produce starkly different results are “spatial approach” and “national approach”. This paper does not contribute to the existing literature by claiming which approach is better. However, it provides an important insight into this decades-old debate by conflating the two different approaches. To be more specific, this paper looks for common ground by using the strategies adopted by national approach to find out if the relationship between immigrants, skills and wages exist as proved by spatial approach. We found evidence for this relationship. Using methodologies predisposed to finding wage losses, which assumes perfect substitutability between natives and immigrants, our results show a 20% decrease in the negative effect if we assume natives specialize in occupations they have a comparative advantage.

The research started by replicating Borjas (2014) spatial approach. The main model used is:

\[ \log w_{ijt} = \beta P_{ijt} + \varepsilon \]

This is a partial-equilibrium, within cell, estimation strategy. The coefficient \( \beta \) indicates the changes in native’s wages in response to the changes in immigrant share of labor force. Our result -0.528 is almost the same as Borjas’ result. However, this result did not withstand stricter data specifications. When a more refined data selection criterion is applied to both dependent and independent variables, the coefficient is reduced to -0.434. A more detailed regression specification found that the impact on the wage structure is mostly concentrate on the lower education groups. The high education groups even experience a positive, though insignificant, wage change.

The research explores the natives’ skill response to immigration by running the regression above on three categories of the skills data: Manual, Communication and Quantitative. For the low education groups, the results reconcile with the expectation based on spatial approach: the natives use fewer manual skill and perform more communication skill, thus reduce the negative impact from immigration. The results for high education group are harder to reconcile. The natives use more manual skill and perform less communication skill. The results from the wage regression, however, show a positive impact on the natives’ wage structure. One explanation for this phenomenon might be the natives entering occupations requiring high manual and low communication skills, such as health and therapy-related occupations.

Our research provides a new approach into analyzing the effect of immigration on the natives’ wage structure. Based on Borjas(2014) national approach, we use more detailed regression specifications. Based on the empirical analysis, we found a smaller negative impact on the natives’ wage structure concentrated on the low education groups, and change in occupations into more advantageous ones among those experience a wage loose to protect themselves.

Research Fellow: Wanqing “Cindy” Han (2017) Concentration(s): Mathematical Economics; COSC

Faculty Mentor: Michael Hay Department: Computer Science


Project Summary:

We took part in research on the privacy aspect of machine learning algorithms. Machine learning is a subfield of artificial intelligence that focuses on recognizing and learning patterns from real data in order to make predictions. For our research project, we were particularly interested in classifiers. A classifier is a machine learning method that uses pattern matching to attempt to assign a label/class to an observation. For example, classifiers can be used to label an email as spam, to predict a patient’s risk level for a particular disease, etc. In certain cases, data that is used to build these classifiers is sensitive (e.g. medical data) and people need a privacy guarantee before they volunteer their data. One of the most prevalent methods of trying to ensure privacy is anonymization or the removal of personal identification information. But when a health insurance company in Massachusetts released the anonymized records of its employees, people were able to go back and re-identify certain records. We see that anonymization doesn’t provide sufficient privacy, thus we need a more robust method of privacy.

Differential privacy is a proposed alternative to anonymization. It ensures that computations be insensitive to changes in an individual’s record. Differential privacy achieves this by adding noise to the statistical computations. There has been much research in the past on differentially private classifiers; however, there has not yet been a comprehensive study of the existing differentially private classifiers. The goals of the project were to look at the current algorithms in the field and do an empirical comparison and to propose possible improvements to current algorithms. We also collected and curated datasets, both new ones and those that have previously been used in other papers. We were able to obtain some preliminary results after running the differentially private classifiers that we had on our collection of datasets.

As part of the project we had to pick an individual project within the scope of the research topic. I decided to work on implementing and replicating the current literature. I completed a comprehensive literature review in the field. I looked at 15 different papers on the topic of differentially private classifiers and of those papers was able to get the source code for 11 of the algorithms. The literature review showed there isn’t a single algorithm that produces the highest accuracy overall. While there is no clear winner the literature showed that PrivBayes, DifGen, and PrivateERM have relatively high performance. Of those 11 algorithms for which I was able to get source code, I was able to implement 7 algorithms in the python setting. With those algorithms I ran an empirical evaluation over many different datasets and compared accuracies. We discovered that many of the complex algorithms offer no significant improvements over a simple baseline classifier known as OneRule. In addition to this we also found that many of the results in papers only uses datasets with very simple classification problems, meaning a simple solution would still provide good performance. Overall, there is no single algorithm that is significantly better than the others.

Source of Support:  
- AHUM Div.  
- NASC Div.  
- SOSC Div.  
- UNST Div.  
- Other (specify): National Science Foundation
Title of Project: Field School Fellow with Friends of Rogers Environmental Education Center

Project Summary:

This summer I primarily worked on creating short videos used to market Friends of Rogers (FOR) in an attempt to increase participation. FOR is a non-profit organization that has been managing and maintaining the NY State Department of Environmental Conservation’s (DEC) Rogers Environmental Education Center, located in Sherburne, NY, since 2011. The mission of FOR is to provide outstanding educational opportunities that excite, inspire, and motivate people of all ages to enjoy, understand, appreciate and protect our natural environment.

By the end of the summer, I created four short videos on specific events/programs, two other videos summarizing what FOR has to offer, and one brief video thanking donors for support. All the videos can be found on the Friends of Rogers YouTube page. In creating these videos I was also tasked with photographing and video-recording most events that occurred over the summer, along with storing and cataloging all the media for my use and future use for FOR. The goal of my work was to create a connection between the community and Rogers; most importantly to tell the story of FOR and to illicit an emotional response filled with nostalgia and hope that FOR can continue to thrive.

The notion that ‘seeing is believing’ has been embraced by FOR in its recognition of the importance of the use of multimedia videos that incorporates footage and photographs from events and programs. Therefore, each video has purpose and conveys a different message while carrying a different tone. For example, the “Story Time and Hike” video (see right) is aimed to reach parents to encourage them to bring children to the weekly program. The video features children’s music from the program, images of the story time circle, video from the hike, and testimonials from a parent and the Children’s Program Coordinator to produce a child-friendly video with a welcoming and light message.

I also found two side projects for myself over the summer. The first was to create a QR code system at four locations that contains links to trail maps, history of FOR, and to the donations page. For the second project, which was much larger, I teamed up with the Children’s Program Coordinator to create a soundtrack CD to the songs she plays on the guitar and sings during her Wednesday morning sessions of Story Time and Hike. By the end of the summer, we had recorded and I had mixed 32 songs, and album cover and insert, and CD artwork that were produced on over 80 CDs to be sold at the Visitor Center.

Research Fellow(s): Cody Hawkins (2016) Concentration: Sociology
Kellyann Hayes (2016) Concentration(s): English; Sociology

Faculty Mentor: Alicia Simmons Department: Sociology

Title of Project: Print Media Framing of the Killings of Unarmed Blacks by Whites

Project Summary:

Professor Simmons' project “From Trayvon Martin to Michael Brown: Print Media Framing of the Killings of Unarmed Blacks by Whites” explores the intersection of media, race, and crime by examining the factors that determine the extent of news coverage an event and the ways in which instances of police killings of blacks are framed when they do receive media attention. The media is a socially constructed entity; every day, reporters, journalists, and news agencies make conscious and unconscious decisions about what events should receive news coverage based on articulated criteria such as the type of event (Chermack1995) as well unarticulated reasons such as implicit stereotypes and biases of gender and race (Tuchman 1978). Newsworthiness is therefore an observable social action whereby reporters and editors selectively choose which events should be made into news and which events should not (Lundman 2003).

In Phase 1 of our research, we compiled a database of 133 events of police killings of unarmed blacks occurring between 1999 and 2000. We noted key variables within the following categories: context of location of event, such as population, percent racial makeup of population, median household income; details about the event, such as reason for the encounter and method of injury to victim; aftermath of event, such as presence of protests and civil rights investigations; victim details, such as age, mental health, and criminal record; and officer details, such as race, rank, and complaints. For each event we then compiled a database of all news transcripts appearing in four broadcast news outlets (ABC World News, CBS Evening News, NBC Nightly News, and NPR All Things Considered) and four print news outlets (New York Times, USA Today, Washington Post, and The Guardian), resulting in a content database of 5,289 news stories.

In Phase 2, we began exploring which events and issues surrounding the death of Michael Brown were deemed newsworthy. For each news story, we coded it focused on events such as criminal justice proceedings, civil rights proceedings, civil suit proceedings, demonstrations, official concessions, legislative action, the funeral, school closings, and officers shot at; and issues such as racial stratification, police practices, public policy, media coverage, and aftermath. In addition, we coded for type of article (e.g., launchpad, straight news, feature, and analysis) and rhetorical frame (e.g., episodic and thematic).

Studies such as those of Behr and Iyengar (1985) show that public opinion about current events and issues are largely influenced by media news. We hope that this study will show us how police killings of unarmed blacks are shaped by the media, and thus influence public opinion of such events.

Figure 1 Number of Stories across News Outlets

<table>
<thead>
<tr>
<th></th>
<th>NYT</th>
<th>USA</th>
<th>Wapo</th>
<th>NPR</th>
<th>CBS</th>
<th>A BC</th>
<th>NIC</th>
<th>GUARD</th>
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<tbody>
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<td>stories</td>
<td>323</td>
<td>187</td>
<td>182</td>
<td>162</td>
<td>162</td>
<td>102</td>
<td>8</td>
<td>3</td>
</tr>
</tbody>
</table>

Figure 2 Prevalence of Issues Covered (Michael Brown)

<table>
<thead>
<tr>
<th></th>
<th>Media coverage</th>
<th>Public policy</th>
<th>Aftermath</th>
<th>Police practices</th>
<th>Racial stratification</th>
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<tbody>
<tr>
<td>stories</td>
<td>3</td>
<td>8</td>
<td>10</td>
<td>33</td>
<td>44</td>
</tr>
</tbody>
</table>

Citations:

Project Summary:

The purpose of this study was to investigate whether the difficulty of tasks (i.e., cognitive load) performed after learning affects the consolidation of previously learned information. Recent research has found that the learning of new information can actually hinder the consolidation of previously learned information into our memory systems. This lack of efficient and accurate consolidation can be linked to the competition between the previously learned and newly acquired information for our limited memory resources. This competition model, however, does not take into account the question of cognitive load, which we believe plays an important role in explaining the consolidation limitations that have been described. We manipulated the level of difficulty of post-learning tasks and then observed how those changes impacted the subjects' ability to consolidate information they had learned prior to the task.

Our experimental design consisted of two sessions, one in the morning and the other in the evening, 12 hours after the start of the first session. We recruited people from the Colgate community to take part in our study, by word of mouth and through an advertisement on Facebook. All of the participants were over the age of 18, fluent English speakers, had normal or corrected-to-normal vision, and fulfilled additional requirements necessary for eligibility. The first session consisted of a learning task, followed by a post-learning task, which was either labeled as low or high cognitive load. This morning session took approximately one hour to complete. Participants came back 12 hours later and were instructed not to nap during that time period, as we wanted to avoid the confounding variable of sleep-dependent consolidation. In the second session, participants once again completed the learning task, which lasted about ten minutes. This was done in order to compare various measures of performance from the first and second sessions, paying particular attention to which cognitive load condition to which they were assigned. The subjects were given three “slices” tokens as compensation for their participation.

Data collection for this project will be continuing through the fall semester. Our goal is to see if the cognitive load of a post-learning task is the meaningful factor that has the most significant influencing the consolidation of previously learned information. More specifically, we hypothesize that a high cognitive load will limit consolidation due to competition of limited cognitive resources in our memory systems.
Project Summary:

My summer research did not necessarily follow the path of a normal research assistant. Originally, I intended to conduct library research on spring sanctuaries in Lucania (a region in southern Italy) as part of the Greco-Roman world. Instead, I was lucky enough to receive hands-on experience in working with ancient artifacts, which came from an actual sanctuary dedicated to a water nymph at Metaponto, an ancient Greek city-state of Magna Graecia (that is, the area colonized by Greeks in the toe of the boot of Italy). Because I also participated in the extended study to Greece this summer led by my research professor, Professor Rebecca Ammerman, I was able to stay on for two weeks after the extended study trip and travel to Metaponto and visit an archaeological site, called Pantanello, that had been excavated from 1976-1982. The archaeological research has just now reached its final stage: the full publication of the excavation.

While I was at Metaponto, a group of 30 or so archaeologists who had been working on different aspects of the Pantanello site all came together and held a conference. I sat in and learned about everything from the significance of certain designs pressed into loom weights, to the chronology provided by the ceramic vessels, to the terracotta plaques that contained a scene of a Nymph dancing with the god Pan. Each archaeologist had worked on a specialized portion of the dig, and it was an invaluable opportunity to be able to listen to each presentation. Ultimately, I learned all the ins and outs of archaeology without the dig. It was extremely helpful for me, as I learned what happens after the “fun part”, or the actual digging.

Not only did I get to sit in on the conference and see at first hand all of the important artifacts recovered during the excavations at the Nymph’s sanctuary, but I also got a chance to get a little dirty. I spent 3 days while I was in Metaponto working in a museum basement. I worked with all of the terracotta pieces that had been found at the site, and my job was to count all of the fractured, unidentifiable pieces. As I was strategically counting out the pieces based on their original location within the site, my professor and I were able to distinguish 90 pieces that had previously been overlooked. My next job was to catalogue these artifacts. For each piece I had to measure the height, mark down the clay color, take a photo, and write down what we believed the object was.

For the rest of the summer, which I spent on campus, I had to input all of the information that pertained to each piece. Not only did I copy the information that I had taken myself while in the museum, but I also had to compare the pieces to models and research that had previously been done on the site. Then I added the new pieces to the pre-existing catalogue, and helped to get the information ready for publishing. The whole summer was an amazing experience that I feel really helped me with my future career, and the hands-on approach was the absolute best way for me to learn what lies in store for me as a Classical archaeologist.
Research Fellow: Tra “Jade” Hoang (2017)  
Concentration(s): International Relations; Religion

Faculty Mentor: Harvey Sindima  
Department: Religion

Title of Project: The Role of Buddhism in Sri Lanka’s Reconciliation Process

Project Summary:

The armed conflict between the Sri Lankan government and the Liberation Tigers of Tamil Eelam (LTTE), which took place in Sri Lanka in the late 20th century, is considered one of the longest running civil wars in Asia. The war finally came to an end in May 2009, after the Sri Lankan military defeated the LTTE, but the tensions between the majority Sinhalese and the minority Tamil in the country remain. These ongoing tensions, coupled with the wounds and casualties that the war left behind, pose enormous challenges to Sri Lanka’s efforts to promote reconciliation and development. In this context, the research project sought to critically assess several initiatives and developmental plans put forward by both the Sri Lankan government and non-governmental organizations (NGOs) around the country in addressing post-war issues, especially those of reconciliation and community healing between the varied ethnic groups. The research indicates that the reconciliation process from the viewpoint of these agents of change has unfortunately left out a great part of the Buddhist thoughts and political narratives so deep-rooted in Sri Lanka’s ethnic conflict during and after the war. Throughout Sri Lanka’s reconciliation process, it is often claimed that religion in general and Buddhism in particular have little to do with the conflict and when it does, it is constrained as only part of the identity that makes up the majority Sinhalese. In an effort to bring about true peace, however, it is important to recognize the critical role of Buddhism in constructing the post-war rehabilitation debate and effectively routing its peace-building principles into existing socio-economic and political initiatives. This study is dedicated to exploring that absence of Buddhism in the current reconciliation process despite its thriving influence in Sri Lankan societal and political life. Upon investigating reconciliation efforts being made in relation to Buddhist ideas and methods, the research concludes that the principles of good governance, social security and human rights are best reflected in the teachings of the Buddha, which can bring about a critique of contemporary life that might in turn have some effect in creating a new vision of society, one that is better geared towards tolerance and peace. Prominent Buddhist leaders and organizations with years long experience of promoting peace in Sri Lanka also have much to offer in terms of their visions and methods to various respects of reconciliation, in which these Buddhist ideas are put into practice through various societal and political measures.

The findings of the project are the direct outcome of a two-week field research in Kandy and Colombo, two major cities in southern Sri Lanka under the generous support of the Lampert Institute for Civic and Global Affairs. The primary objective of the trip was to acquire scholarly materials and resources on peace and reconciliation in Sri Lanka that are not available in the U.S. During the trip, I was able to make contacts with intellectuals in the field who were willing to share their knowledge and reference important works on the subject of post-war reconciliation in several research centers and peace institutions. I also paid visits to prominent publishing centers and NGOs in the areas where government-issued documents, journals and local newspaper were available for the general public and for research purposes. Finally, I was able to conduct interviews with some local people about their experiences with the war and how these experiences came to shape their attitudes on the issue of reconciliation. Given the short duration of my stay, plus my language and geographical limitations, the examples and interview results included in the study only serve to disclose a number of ways in which changes are being carried out and perceived, rather than a synopsis of the entire reconciliation process taking place. This study therefore was not to be a quantitative research, but rather a qualitative research relying upon available resources and documentation in Sri Lanka.

Title of Project: Functionalization of a Transition Metal Complex to a Metal Peroxide

Project Summary:

The focus of this project was to analyze different mechanistic pathways for a reaction involving the insertion of oxygen ($O_2$) in a rhodium hydride bond (Rh-H) in order to create a transition metal peroxide complex (Rh-OOH). The potential energy surfaces of two different reactions, each with multiple pathways, were computed using the program Gaussian 09. The two transition metal complexes studied in this project were a Rhodium-Porphyrin complex (Figure 1) and a Rhodium Cyclam complex (Figure 2), the former being significantly larger than the latter and requiring more computing time.

![Figure 1](cyclam-RhIII (H_2O))^2+  ![Figure 2](porphyrin)RhIII

The project explored the energies of three different spin surfaces using identical mechanistic pathways, the goal being to determine what factors affect the experimentally observed differences between the two complexes. The mechanistic aspects of this project was performed by examining the possible intermediate states involved in each reaction pathway, as these steps are crucial to determining the most efficient reaction pathway. Pictured below are the desired results for the end of the reaction, in which the complex metal is functionalized into a metal peroxide complex.

![Figure 1]  ![Figure 2]

**Research Fellow(s):** Ellen Hutchinson (2018)  
Gillian Murray (2017)  
Gian Sepulveda (2017)  

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

**Title of Project:** The Association between Circadian Rhythms and Physical Activity

**Project Summary:**

The focus of our research was on the human circadian rhythm and its effect on workout performance. To clarify, various daily physiological processes are influenced by the circadian rhythm, also referred to as the body’s internal clock. Several peripheral clocks exist in humans and these clocks are governed by the “master clock”, also known as the SCN (suprachiasmatic nucleus). The oscillations in the expression of certain “clock genes” such as Period3 and Nr1d2 control this internal clock. Individuals exhibit different rhythms/oscillations of these genes and therefore experience different timings of their everyday activities. Thus, humans often display a preference for activity in either the morning (larks) or the evening (owls).

Here, we aim at understanding the differences in physiological performances during workouts while considering chronotypes, genotypes, and the rhythmic expression of clock genes. Participants were asked to complete a morningness-eveningness questionnaire (MEQ) and a survey with questions regarding their workout (i.e. tiredness, hardness, duration) (See 1). After the brief survey, the participants consented to a DNA hair pull (See 2). Furthermore, depending on the score of their MEQ, “extreme” participants were chosen to collect hair follicle samples for observing their expression of the clock genes (See 3). Participants were then asked to complete a second survey after a workout during the opposite time of day (i.e. if the first survey was filled out during the morning, we asked the participant to complete the second survey post-afternoon workout). Using the data from both surveys, DNA from the hair pull, and the RNA samples from the select participants, we aimed to find associations between the participants’ workout preference and genotypes, in addition to their rhythmic gene expression.

1. Habitual workout times of participants matched their MEQ scores; morning workouts were dominated by morning people and evening workouts were mostly dominated by evening types (Figure 1). We also found significant differences in MEQ scores among the preferred workout times. People who preferred to work out in the morning had higher MEQs, while people who wanted to work out at night had lower MEQs. We did not find a significant difference in the tiredness or hardness levels between morning and evening workouts for larks, owls and intermediates, but we found that owls and intermediates work out significantly longer in the evening. Comparing larks and non-larks, larks generally had a significantly lower perceived tiredness level in both their morning and evening workout than the non-larks.

2. Additionally, researchers have found an association between single-nucleotide polymorphisms in certain clock genes, namely Period3 and Clock3111, and diurnal preference in humans. Thus, DNA samples from participants were analyzed to understand if there is significant variation in allele frequencies in larks and owls. Despite finding no significance in our population, we believe that with a larger sample we may find relationships between the allele variants, diurnal chronotypes and physical activity.

3. We also examined the expression levels of oscillating clock genes in 16 “extreme” morning and evening participants (MEQ >59, <41, respectively). Participants collected hair follicle samples at 3 different time points (7h, 15h, 23h) and using a standard-curve method, gene expression phases were predicted. In Figure 6, we observe a phase delay in most owls and a phase advance in most larks. This suggests that the variation in individual circadian rhythms governs the timing of various physiological processes, and thus when one prefers to engage in activity.

**Source of Support:**  
AHUM Div.  
NASC Div.  
SOSC Div.  
UNST Div.  
Other (specify): Harvey Picker ’36 Institute for Interdisciplinary Study in the Sciences and Mathematics
Research Fellow: Angela Jang (2017)  
Concentration: Sociology

Faculty Mentor: Elana Shever  
Department: Anthropology

Title of Project: Prehistoric Traces and Popular Icons: The Cultural Politics of Dinosaurs in the United States

Project Summary:

A month before my research started, the movie *Jurassic World* opened to millions of spectators. Within the opening week, *Jurassic World* swept through the box office with an income of two hundred million dollars, earning the second-best domestic movie opening ever (Cieply 2015). But the obsession with dinosaurs does not seem to end with *Jurassic World*. *Dinosaur Train*, *Barney & Friends*, and *Land Before Time* are simply some of the many shows, movies, and books that are heavily based on anthropomorphized dinosaurs. So, why are millions of people in America paying thousands of dollars to watch these shows? What do dinosaurs mean to people in the United States anyways?

Dinosaurs represent a paradoxical relationship between science and pop culture. The former is often based on excruciating and meticulous methods while the latter is often associated with unreliable imagination and popularity. The dinosaurs that most lay people know are a blend between scientific facts learned from studying the fossilized remains and the awe-struck imagination of monstrous and carnivorous creatures. This mixture that creates what we call “dinosaurs” for American society is formed through a complex and dynamic interactions between the experts (or those who have scientific in-depth knowledge of dinosaurs), knowledgeable lay people (or individuals who have received educational training from experts), and unknowledgeable lay people.

To understand this relationship, Professor Shever has been conducting ethnographic research in bustling museums and parks in Colorado, a state rich in fossils of dinosaurs. She has conducted interviews, carried out participant-observation and administered surveys with the employees, volunteers, and visitors there. These materials were brought back to the university to be transcribed, analyzed, and coded. To prepare the materials for analysis, I transcribed hours of interviews, and recordings of museum sponsored programs and tours. In addition, I scanned museum publications such as brochures, magazines, and new articles to prepare for coding. When all the materials were ready to be analyzed, I uploaded them onto a software called MAXQDA, a qualitative dating analysis application, to identify recurring themes. An example of a code I found frequently is “real vs. other,” which represents the interviewee making an explicit or hinted distinction between actual fossils and casts. In addition, I helped create codes such as “truth vs. falsehood,” which applies to areas where the general lay people stated false information about dinosaurs during their interaction with the expert and/or knowledgeable lay people.

While coding themes, I was constantly surprised by people’s unconscious decision to gender dinosaurs, with herbivore dinosaurs as female and carnivore dinosaurs as male. However, this unconscious decision – which is influenced by various factors such as personal background – actively flows from one person to another, creating a chain of complicated relationships. The research has also made me aware of the richness in the topic of science in pop culture, which has been in increasing popularity in the media but often disregarded as simply fictional in many minds. In terms of experience and skills, I gained necessary skills to transcribe, document, and code qualitative data using modern software such as MAXQDA. This will be beneficial for both my independent senior research and my future career as a researcher.

Source of Support:

☐ AHUM Div.  ☑ NASC Div.  ☑ SOSC Div.  ☑ UNST Div.

☐ Other (specify):
Research Fellow: Leah Jenks (2017) Concentration: Astronomy/Physics
Faculty Mentor: Thomas Balonek Department: Physics and Astronomy
Title of Project: Optical Variability of the Blazar 454.3

Project Summary:

My research this summer focused on the optical variability of a particular blazar, 3C 454.3. A blazar is a subset of objects known as quasars, which are a type of active galactic nuclei. AGNs are generally classified as distant galaxies with active cores. These objects vary in brightness, which is what this project focused on. The majority of my summer was spent compiling and analyzing the historic light curve and variability of this object by gathering data from multiple sources and making interactive graphs using Python. Using MatPlotLib widget features in Python, I was able to create several types of interactive graphs. The first example has check buttons that allow a user to select a particular subset of a data set to view on a graph. This was helpful for comparing data from different filters or sources on a single graph. I was also able to create a span selector widget that allowed the user to select a particular section of the graph to zoom in on and see in more detail.

I also worked on the historic light curve of this object. Previously to this summer, the largest compilation of data we had started in 1988. My colleagues and I compiled observations from papers available online and correspondence with other scientists. I also made corrections to the older data sets that had offsets due to the different methods of determining the magnitude of this object. Ultimately, the finished light curve covers the range of 1899 to 2015 and contains data from six different sources, including our own observations at Foggy Bottom Observatory using the 16” telescope and Star 1 CCD camera.

☐ Other (specify):
Research Fellow: Li Jiang (2017)  
Concentration: History

Faculty Mentor: John Crespi  
Department(s): Asian Studies; Chinese; EALL

Title of Project: Scanlating Chinese *Manhua* Magazines

Project Summary:

*Manhua*, or Chinese comics, has become popular since early 20th century. These highly stylized cartoons, often satirically commenting on political events, provide the readers with a window into the society of their creation. These *Manhua* sometimes possess propagandistic functions, especially since the founding of People’s Republic of China. However, as Professor Crespi argues, they exhibit much more than communist ideologies. Audience should appreciate cartoons with their carrier, the *manhua* magazines.

Professor Crespi uses sample issues from magazines of different time period to analyze the history of Chinese *manhua* magazines. To present them to a wider audience, the magazines need to be in English. We used the technique of scanlation, developed by early Japanese mango aficionados. The idea is to scan the original cartoons and substitute the Chinese language with English, while preserving the format and design as much as possible. The translated whole issues, along with introductions, will appear in Professor Crespi’s book *Sensation and Satire: A Magazine History of Chinese Manhua, 1918-1960*.

This summer research project mainly dealt with issue 92 of *Manhua* Magazine from 1957. We used Photoshop to erase the original Chinese. Professor Crespi worked on the translation and I helped edit and typeset. The project not only involved expunging original words, but also in rearranging the places of the cartoons on the place. Professor Crespi was constantly abridging the English translation to make space because the Chinese is more condensed than English. From time to time, I would look up a quotation in the magazine and find its source for later citation as well.

The following pictures are the original cover page in Chinese and the translated and edited in English.

Title of Project:  Photochemical pathways to the chemical production of secondary organic aerosol

Research Fellow:  Yutong Jiang (2018)  
Concentration:  Undeclared

Faculty Mentor:  Ephraim Woods  
Department:  Chemistry

Project Summary:

Aerosol particles are any solid or liquid particles that suspend in the air. Because they play an important role in scattering and reserving solar radiation, we cannot ignore their huge effect in the atmosphere. However, not only these aerosol particles, but also the products of the chemical reaction of these aerosols play a significant role. The reactions of volatile and semi volatile organic compounds by gas phase oxidizers, such as OH, Cl, NO3, and O3, produce non-volatile species that condense into the particle phase. This secondary organic aerosol (SOA) represents a large fraction of the overall organic aerosol burden. They also affect the Earth’s radiation budget through scattering and absorption. But the processes are poorly understood. Our ultimate project considers a photochemical pathway to SOA wherein excited triplet states of organic species react with volatile organic compounds to produce SOA. As a step along the way, we measure reactions with particles-bound organic molecules, which may also contribute to SOA chemistry.

The experiment setting is like the graph on the right. We made a solution of sodium nitrate(NH4NO3) and sodium anthraquinone(SAS) to create flow of aerosol particles. We used a DMA to select size, and controlled relative humidity by altering the ratio of wet and dry air. For the ionization cell, a 355-nm laser excites the SAS, creating the triplet state through internal conversion. The 230-nm laser selectively ionizes the excited triplet SAS. We monitored this charge using an electrometer while scanning the delay between the lasers. For the first part of our experiment, we varied the RH and measured the ionization signal. For the second part, we added varying concentration of succinic acid and 50% RH, and then measured the ionization signal.

Our results are very clear. For the first experiment, we find that higher relative humidity leads to shorter half-life. The triplet lifetime is larger than 3 microseconds for low relative humidity. For the second experiment, with higher concentration of succinic acid, the triplet lifetime gets shorter. Preliminary data show that the trend follows Stern-Volmer plot. In conclusion, we cannot ignore photochemical pathways for SOA, especially at low RH formation.

Graph 1: Settings

Graph 2: RH dependence of triplet lifetimes

Graph 3: [succinic acid] and triplet lifetimes

Source of Support:  
☐ AHUM Div.  ☐ NASC Div.  ☐ SOSC Div.  ☐ UNST Div.  
☒ Other (specify):  Miller-Cochran Fund
Project Summary:

Loanwords in Japanese number in the thousands, many of which come from English. Still, English-speaking students often struggle to identify words from their native language. This is because English words that are borrowed into Japanese undergo several adaptations. The focus of my research this summer was to understand these adaptations and how it can influence the transcription of an English word in Japanese. In my research paper, I reviewed relevant literature, organized phonological rules from the information found in various sources, and categorized words from the Japanese textbooks used at Colgate University to show those phonological rules.

Japanese has borrowed words from several different languages starting as early as the 1600s when Japan first had contact with Europeans. The initial period of contact Japan had with English speaking countries was brief; the English were in Japan for ten years, 1613-1623, and no words were borrowed during that time. Following this, there were two major time periods when English loanwords entered Japanese: the Meiji era beginning in 1868 and the post-WWII occupation of Japan by the United States. Since then, thousands of words have been borrowed into Japanese, helped in part by expanding social media.

In Japanese there are NOCODA and *COMPLEX constraints, discussed in Optimality Theory; the former dictates that a syllable must end in a vowel- i.e. no final consonants, and the latter referring to the constraint against consonant clusters- i.e. no more than one consonant associated with one vowel. Consequently, when an English word that includes multiple consonants next to each other is borrowed into Japanese, vowels are inserted in between the consonants to create consonant-vowel pairs.

NOCODA: ‘pet’ \textit{petto}; ‘bus’ \textit{busu}; ‘hotel’ \textit{bateru}

*COMPLEX: ‘milk’ \textit{miruiku}; ‘toast’ \textit{toosuto}; ‘speech’ \textit{supeichi}

The process of inserting a vowel into a word is referred to as vowel epenthesis and is one adaptation that loanwords undergo; another is consonant germination. When a consonant is geminated, or doubled, it is pronounced for an audibly longer period of time than a short consonant. Consonant germination takes place in loanwords either when a short vowel precedes a consonant, in words like ‘pet’ \textit{petto}, or when there is a pattern of short vowel + consonant + short vowel + consonant, in which case the word-final consonant is geminated, like ‘classical’ \textit{kurashiikku}.

Still, it is important to keep in mind that not all loanwords experience alterations like vowel epenthesis and consonant germination. In some instances the conversion is simpler, and such is the case for ‘America’ and ‘sofa’ transcribed as \textit{amerika} and \textit{sofa}. By looking at these aspects of loanword transcription, it is apparent that loanword phonology is intimately related to native phonology and a study of one informs on the other.
Glycoproteins are found on the cell surface and play an important role in cell functions including cell signaling. One particularly important glycoprotein is the MUC1 glycoprotein, which is part of the O-mucin family of proteins. Extensive oxygen-linked glycosylation is characteristic of the MUC1 protein in healthy cells. In many different types of cancerous cells however, this glycosylation becomes truncated. Tn antigen is a truncated form, containing only a galactosamine, and thus is recognized as a marker for disease. Tn antigen is being used as a component in vaccine development but, due to the nature of the instability caused by the oxygen linkage, is susceptible to acid and base cleavage, as well as enzymatic hydrolysis, making it very challenging to study in depth. This summer’s research was aimed at synthesizing the building block molecules that would be used to make a more stable and conformationally viable Tn antigen mimic. In order to do so, we plan to synthesize a molecule with a carbon instead of the oxygen that is found in nature, preventing the aforementioned cleavage and hydrolysis. Furthermore, NMR studies have proven the retention of the molecules shape is through that same oxygen hydrogen bonding with surrounding atoms. In order to maintain this shape, without the presence of this oxygen linkage, we aim to install a hydroxyl group that will essentially play the same role in hydrogen bonding.

In order to synthesize such a molecule, an amino acid olefin and carbohydrate olefin need to be prepared as precursors for cross-metathesis. To prepare the carbohydrate, a series of protection and deprotection steps need to be completed, followed by a Wittig reaction. We began with the addition of the allyl protecting group, followed by the methanolysis of the molecule, and then the addition of the 4,6-benzylidene protecting group. Next was the selective benzylation of position 3, which proved to be a bit more capricious than anticipated, causing us to begin to consider other routes. The obstacle of selective benzylation was overcome, but during the meantime, we came up with a revised synthetic plan that would produce a synthetic equivalent of the product needed for the Wittig reaction in just two steps by the addition of 6-trityl protecting group and the addition of a 3,4-isopropylidene protecting group on to a galactose.

Both pathways will be ready to continue on to the Wittig reaction step, which will provide the olefins needed to perform a cross metathesis with the amino acid olefin.


Figure 1: The molecule on the left shows the oxygen linkage as found in nature while the molecule on the right shows how the Tn antigen will retain the same shape through the placement of the hydroxyl group, while replacing the O-linkage with C-linkage.

Figure 2: The molecule on the left is the 4,6-benzylidene-3-benzyl galactose synthesized using the original pathway, while the molecule on the right is the 6-trityl-3,4-isopropylidene galactose synthesized from the revised pathway.
Title of Project: Homosexuality in the Arab World: Critical Approaches

Project Summary:

I spent the first five weeks exploring the work of seven different scholars to help me situate the problem of homosexuality in the Middle East. I read Michel Foucault’s *History of Sexuality* (1976), Edward Said’s *Orientalism* (1978), Stephan Murray’s “Islamic Homosexualities: Culture, History, and Literature” (1997), John Gagnon’s “Sexuality in the Arab World” (2006), Jaspir Puar’s *Terrorist Assemblages* (2007), Kathryn Babayan’s *Islamicate Sexualities: Translations across Temporal Geographies of Desire* (2008), and Joseph Massad’s *Desiring Arabs* (2007) and *Islam in Liberalism* (2015). In the latter part of my research I focused specifically on the foundational arguments of Foucault and Said, specifically their insight into the relationship between knowledge and power in the construction of the homosexual and the Orient as others to a dominant straight, Western identity. These arguments are basic to the project of sexual freedom within the Arab world and elsewhere. I have concluded my research by outlining an argument, which I hope to develop as my English Department honors thesis next year. What follows is an abstract.

We commonly read Foucault as though it were 1977, or as though Edward Said had yet to publish his groundbreaking critique of Orientalism, the discourse that continues to sustain a division between East and West and to monopolize knowledge and power in the academic, medical, state and now, increasingly non-governmental institutions of the Occident. We commit the Foucauldian sin of canonizing Foucault and his *History of Sexuality*, disregarding his own genealogical methodology and skepticism of foundational discourses. Though we critique this work, refining its local arguments and supplementing its historical researches, we have been slow to address the *History of Sexuality* as a work of orientalism in its own right, one that despite the force of its critique reifies as normative Western paradigms of sexual identity. But Foucault would be the first to invite us to read his work sacrilegiously, to assail the iconography of ‘Saint Foucault’, and to challenge those aspects of his work that risk reproducing the logic of modern biopower. It is my contention that the *History of Sexuality* can indeed be read differently, aligned with a more powerful conception of the geographies of power and normativity. While it is true that Foucault does not explicitly address questions of sexuality outside the West, save as an undifferentiated ‘ars erotica’ from which the modern, Western science of sexuality departs, my desire is not to castigate him for this oversight but rather to ask how reading Foucault and Said together can help us think the critique of biopower with a sustained critique of the forms and discourses of colonialism. This is the point of intersection from which I believe it possible to envision a politics of sexual freedom that no longer replicates Western discourses of identity and rights, and instead opens itself towards a Foucauldian future of ‘bodies and pleasure’ – in the West and in the Rest.

This research fellowship has provided me with the intellectual space I needed to hone and refine my analytical, research and critical writing skills. What I gained from my intense intellectual engagement with Professor Connor goes beyond anything I can summarize here. But if I am forced to elucidate a fundamental truism that I learned from him, it will be this: *Historicize the author*. Only through such an act would it be possible to understand an author’s work and scholarly trajectory.

Title of Project: Schools in Sin City: The Las Vegas Education Machine and Its Operations in the Casino-Oriented Environment

Project Summary:

While the glitz of Las Vegas has attracted much scholarly attention, few studies have looked beyond readily visible phenomena such as the rapid economic growth or the semiotic significance of the Strip. This study seeks to illuminate another dimension of life in Las Vegas, by examining local educational challenges in relation to the dominant presence of the casino-entertainment industry. More precisely, this study focuses on the mechanisms through which the operations of casinos shape those of the local education system in Las Vegas especially since the casino-driven economic expansion of the city in the late 1980s. In this study, based on Gille Deleuze and Félix Guattari’s ontological framework, Las Vegas education is analyzed as a machine that operates by drawing and extracting various flows from its environment. Four such flows are identified and analyzed: student flows, educator flows, resource flows, and information flows (See Figure 1). This study investigates how particular characteristics of each flow result from the operations of casino-entertainment industry in Las Vegas, and presents specific critiques of the local education “machine” and its operations as well as the local education system’s responses to the challenges these flows create.

During the course of this project, I had in-depth interviews with nine participants, studied the literature on the history of Las Vegas’s recent development, and examined the public records and journalistic articles in order to approach appropriately to the complexity of the Las Vegas education. In addition, by spending over two months with a local family in Las Vegas, I sought to understand the prevalent, yet often taken-for-granted presence of casino-entertainment industry in the people’s everyday life in the region; in order to achieve this, I kept taking ethnographic field notes as often as possible throughout my stay in Las Vegas.

Although this study offers a somewhat pessimistic vision (e.g., the overwhelmingly large class size, teacher shortages, insufficient funding for public education and little appreciation for education from the locals), it must be stressed that the risk simultaneously presents possibilities for changes that are hitherto unexplored and unrealized. After all, Las Vegas is still a young metropolis that experienced a dramatic surge in population over the last two and a half decades. Referring to the opening of the Smith Center for the Performing Arts, one of the interviewees remarked, “It’s 2012 and we finally have a cultural venue. So it’s not surprising that we don’t have an education infrastructure that supports 1.6 million people.” Just as the city’s unparalleled rate of growth in recent years was largely unanticipated, the future of its educational machine, as well as of the environment it faces and the characteristics of the flows it draws, cannot be fully determined by the status quo.

Title of Project: Metamorphism in Dutchess and Litchfield Counties, NY and CT

Project Summary:

This summer, I worked on two projects studying metamorphic rocks in Southern New York state and Western Connecticut. Over ninety samples were collected over a week-long field period. The primary study seeks to examine marbles across a preserved Ordovician regional thermal gradient and determine the maximum temperature experienced during metamorphism. The secondary project was carried out in an attempt to confirm a report of the mineral glaucophane in metamorphosed sedimentary rocks in the Clove Valley area of Dutchess County, NY.

In the marble project, the fractionation of carbon isotopes is used to determine the temperatures experienced by the rocks during metamorphism. Calcium carbonate, CaCO3, is the major constituent of marbles, and the rocks also contain a trace amount of graphite, pure carbon. During regional heating, carbon is able to exchange between the minerals, causing the fractionation of the heavy and light isotopes as a function of temperature. By comparing the isotopic abundances of carbon in the calcite relative to the isotopic abundance in the graphite, a thermal profile can be created for the rock. Our samples were selected from a region with a known geothermal gradient, and one goal of my research is to show how temperature is recorded in the region in other geologic units.

After completion of the field work, marble samples were selected for preliminary analysis from across temperature zones. The chosen samples were then crushed into sand sized grains, and filtered twice to extract graphite grains. The graphite was dried and prepared for combustion within a mass spectrometer. The remaining material was used to select for calcite grains to dissolve using H3PO4. The released CO2 was collected for isotope analysis. In the fall semester, I will be continuing this project as part of my senior research project and thesis.

The second project, identification of glaucophane in metamorphic rocks from Clove Valley, is an attempt to verify a report of this mineral in this area from 1936. Glaucophane is a mineral formed under high pressure conditions, but at relatively low metamorphic temperatures. This locality is the only reported site of the mineral in New York State, and is important for our understanding of the metamorphic conditions during past orogenies. Samples collected this summer did not contain glaucophane visible in hand sample and were examined more closely with a variety of methods. Thin sections were examined for these samples to determine the basic mineralogy of the rocks. The samples are currently in the process of being studied using the Scanning Electron Microscope (SEM). The SEM can be used to determine chemical composition for grain within a rock, and the resulting X-ray energy spectrum can be matched to known minerals for chemical identification. This project will also continue into the fall to determine if glaucophane can be determined to exist in the Clove Valley samples.

Special thanks to my advisor, William Peck; Di Keller and Dave Linsley for their help with sample processing and analysis; and Matt Quinan and Taylor Dawson for their assistance conducting field work.

□ Other (specify):
Project Summary:

Our project was focused on understanding the collective behavior of a non-linear system, the neural network, using Josephson Junction circuits. Nonlinear systems are those whose output is not directly proportional to the input, and appear in many coupled systems in nature such as hurricanes, protein folding, the spread of disease, pendulums and the focus of our project, neural synchronization. Many have studied neurons at the cellular and molecular level, but there is still ways to go in understanding how large networks of neurons come together, communicate and operate as they do in the human brain or spinal cord. Contemporary simulations (both digital and analog) of such networks, while successful, are limited by computation time, complexity, and power requirements. A group at Colgate proposed a new analog method for studying the dynamics of neurons using Josephson Junction circuits. A Josephson junction is made up of two superconductors that are separated by an insulating barrier. The junction is a non-linear system because three different kinds of current can flow across the junction depending on how much current is applied to it. In fact, the form of the equation that describes the total current in the junction is exactly like the equation of motion that describes the movement of a pendulum. The nonlinear dynamics of the junction makes it an ideal candidate for modeling the behavior of neural networks. The JJ neuron contains two of these junctions connected in a loop, and is designed to reproduce biological properties of neurons like action potentials, firing thresholds and refractory periods. In our experiment, we couple two of these neuron circuits together by using the signal from the synapse of the first to trigger the second one and vice versa.

Our experiment is targeted at studying the phenomenon of phase flip bifurcation. A network of mutually coupled and constantly firing neurons behave like a system of coupled identical non-linear oscillators. They act as though they are connected within some coupling medium (the synapse) which determines the coupling strength between them. In such a system, the mutually coupled neurons will synchronize either in-phase or out-of-phase depending on the synaptic coupling strength. The observation of a phase-flip bifurcation while varying coupling parameters is indicative of effective communication between the Josephson Junction neurons. We vary the coupling strength between the neurons using a SQUID (Superconducting Quantum interference Device) as a variable inductor to control the amplitude of the pulse traveling between the two neurons. A Josephson Junction OR gate lets us observe the relative phase between the signals from the two neurons and tell us whether they are firing together or not. Previous work in this project has led to the demonstration of phase-flip bifurcation computationally, as well as experimentally for one superconducting chip containing two coupled neuron circuits. This summer, we worked to produce more precise computational models based on the results of previous experimentation. Moreover, we experimented with a new superconducting chip. We were able to synchronize the two neurons on the chip and observe phase flip bifurcation. We also began computationally simulating these results. The following diagrams show: (a) the JJ neuron circuit, (b) experimental phase flip bifurcation observed by Matt LeGro ’15 where red = out of phase and blue = in phase, (c) computational simulation of Matt LeGro’s results done over the summer.

1) Superconductors are materials whose electrical resistance goes to zero when cooled below a certain temperature. In our experiment, we use a liquid helium cryostat that cools our samples down to near absolute zero temperatures.

Project Summary:

While a study of dinosaurs may at first sound like the work of paleontology, the unique space we have carved for these prehistoric animals in our everyday lives has turned them into a sort of cultural phenomenon. In other words, this study is not a study of the dinosaurs themselves, but their place in the cultural context of the United States. The study aims to understand how popular knowledge about science is created, presented, and recreated, and seeks to gain more insight into our cultural understanding and interpretation of science. This knowledge produced by scientists is often presented and reinterpreted to larger audiences through cultural mediums like education and popular media. However the connection/disconnection between science and its mediums of translations often leaves gaps of knowledge and understanding. Dinosaurs provide an interesting lens to study this process, as they hold a high level of general interest in the United States, which is not held universally or present innately, making them a prime focus for studying American culture. The forms in which they are portrayed do not always line up with one another, nor do they properly align with the understandings that paleontologists and other professional scientists have of the creatures.

Acting as a Research Assistant for Professor Shever, an anthropologist in the SOAN department, I was able to gain more experience in my major and intended career path. In addition, the project provided me a unique opportunity. Since Professor Shever's work is conducted in the United States, I was able to travel to her field site and participate in the actual data collection process. In anthropological studies, where travel and language barriers abound, it is rare to be afforded a project with a population of such high accessibility. This meant that the first two weeks of the internship were spent in Colorado. I primarily assisted by conducting surveys, performing participant-observation, and writing up field notes each day. I spent the remainder of the summer transcribing the various interviews, tours, and sessions of participant observation that Professor Shever recorded over the past two years, entering the survey data, and using the analysis software program Maxqda to code the data.

Participation in the project proved to be especially interesting, as it challenged much of what I had previously ignored about dinosaurs and popular knowledge in the United States. Before beginning this project, I had never considered the possibility that the dinosaurs that existed prominently in my childhood classrooms, favorite movies, and television shows demonstrated something unique about the United States. As I continued to work on the project, I listened to many participants in both the surveys and interviews discuss what it is about dinosaurs that intrigues so many. The answer is still not entirely clear, but themes that appeared frequently made reference to the size of dinosaurs, their extinction, and their perceived dominance. Many participants in both the surveys and interviews also referred to dinosaurs as having an ‘imaginative’ aspect, though they are very much real creatures. It also became clear to me that I had absorbed a great deal of inaccurate dinosaur knowledge over the years. During the coding process, I created one category called “dinosaur deception” that included codes for prehistoric animals often confused with dinosaurs. Until this project, I had considered many of these animals—such as the Pterodactyl—to be dinosaurs because of how I was taught and the types of media I have been exposed to. I also learned that birds are descendants of dinosaurs, which I had never heard previously, even though it appears to be a generally accepted in the paleontological community. In addition to increasing my knowledge of dinosaurs, I gained the invaluable experience of learning more about my intended profession as an Anthropology professor and researcher.

Project Summary:

In 2014, the Counseling Center Director Survey found that 94% of directors reported an increase in the number of students on campus with significant psychological issues (American College Counseling Association). This recently increasing demand for behavioral and mental health counseling on college campuses calls for similarly increasing counseling resources. While most colleges offer traditional counseling services, this growing number of students facing psychological distress might suggest a shift in issues students face and thus, a need for new therapy approaches. Animal Assisted Therapy, or AAT, despite research suggesting its positive impact, remains relatively scarce on college campuses. This summer, I addressed the following research questions: What about the culture on college campuses today breeds certain types of mental health issues and what about animals provides a unique type of remedy? Why do different colleges support or not support the possibility of using animals in a therapeutic setting on campus?

In order to answer these questions, I examined existing literature from a broad range of sources. Previous research provides empirical data suggesting that the use of animals in therapy may be beneficial to the therapy process and outcome (Kamioka et al., 2014). These science-based studies support the recent explosion of heartwarming stories found in popular culture that celebrate the unique and profound connection between humans and animals.

To bridge these findings from literature to the issues on college campuses, I conducted IRB-approved interviews with a therapist who practices AAT and residential life and counseling center staff from a range of colleges. In these semi-structured interviews, I asked questions regarding the popularity of current animal therapy programs, the current use of counseling services, the types of students who frequent the counseling center, and the possibility of introducing AAT on campus. To better understand the use and benefit of using animals in therapy, I spoke with a licensed psychologist who practices AAT. She explains, that similar to other types of therapy, AAT endeavors to create distinct lasting change and progress in clients presenting different types of mental health issues (Karol, 2012). She elaborates that during AAT, “every interaction is different and each person brings out a different thing in the horse. The horse gives immediate feedback, and if it’s guided therapeutically, if you point to it, that horse is the therapist.”

During the interviews I conducted, no participants from college campuses displayed complete understanding of this type of therapy, suggesting that many colleges may overlook AAT. The unique cultural issues that college students experience today, such as an intense focus on materialism and the rapidly increasing use of technology, suggest that a less traditional and more holistic remedy, such as AAT, might be needed. This research attempts to start a conversation between scientists, therapists, school counselors, and the general public to create a better understanding of the use of AAT in a college setting as a way to increase awareness about this promising therapy.

References

Glycoproteins are proteins with glycan (carbohydrate) attachments. On the cell surface, they play a role in major functions such as cell-cell interactions. Tn antigen, or GalNAc-α-1-O-Ser/Thr, is a special carbohydrate structure bound to serine or threonine usually found on the surface of cancerous cells as opposed to healthy cells. Tn antigen has been under extensive investigation for use in cancer vaccine development, but its metabolically degradable oxygen-linkage between the galactose and the Ser/Thr has raised questions about its practicality.

Our overarching goal was the synthesis of a Tn antigen mimic that is more conformationally stable and metabolically robust, and thus better suited for research than the natural oxygen-linked structure. The susceptibility to acidic hydrolysis posed by the O-linkage in Tn antigen is resolved in the mimic by replacing it with a C-linkage. A hydroxyl group (OH) was added to the carbon on the linking chain as hydrogen bonding with water molecules was observed to contribute to the antigen’s conformation.

We synthesized C-vinyl-Gal 2, a precursor to the Tn antigen mimic (CHOH)-GalNAc-α-Ser 1 in 7 steps that included adjustment of protecting groups, Wittig reaction, olefin cross-metathesis, and finally palladium cyclization. The precursors synthesized in the lab will be used in the coming year to synthesize the Tn antigen mimic 1.
The focus of our research this summer was the charge efficiency of iodide-containing aerosol particles upon excitation with a laser. Aerosol particles are a particularly interesting area of study in physical chemistry because they exist everywhere around us. In every breath we take, we inhale thousands of aerosol particles that can come from a variety of both natural and man-made sources. Additives to the surface of aerosol particles, known as surfactants, can enhance or diminish the energy that is released upon excitation with a laser. This in turn affects the charge efficiency, giving us insight into the chemical environment at the surface of the particle; which then has implications in issues such as global warming.

We chose to focus on a natural source that accounts for an incredibly large quantity of atmospheric aerosol particles: sea spray. Sea spray was chosen because it is known to contain high amounts of iodide, a halide ion that, due to its polarizability, is able to exist in the interfacial layer (air-water boundary) of an aerosol particle. This ability is unique to iodide and allows us to measure the amount of surface iodide using a laser beam. When the particle is excited by the laser, the iodide ions on the surface emit photoelectrons. The number of photoelectrons detected correlate with the charge efficiency of the particle; the more electrons that detected, the greater the charge efficiency.

A surfactant is an amphiphilic molecule that contains a polar head group with a fatty carbon chain attached. The ionic portion passes easily into the aqueous particle, but the hydrophobic carbon chain prevents the surfactant from completely entering the particle—thus embedding the surfactant in the air-water boundary of the particle. We chose to focus on a cationic (Hexadecyltrimethylammonium bromide, HDTABr) and an anionic (Sodium Dodecyl Sulfate, SDS) surfactant.

In our experiments, I made solutions with varying iodide concentrations and ratios of surfactant (cationic:anionic). We put these solutions through an atomizer and excited the resulting aerosol particles with a laser. The resulting data showed that in predominantly cationic surfactant ratios (100%, 75% HDTABr), there appeared to be a significant increase in charge efficiency of low iodide samples (~0.7% I\(^{-}\) (aq)) that wasn’t seen in mostly anionic ratios. However, as more iodide was added, charge efficiency appeared to drop drastically and then gradually increase (between 1 and 10% I\(^{-}\)). For this, we attributed two possible explanations. Firstly: at low concentrations of iodide, the large net positive charge from the numerous cationic surfactant molecules attracts iodide to the surface of the particle, enabling a greater amount of photoelectrons to be emitted. Alternately: the low concentration of iodide creates a unique electrochemical environment where the iodide ions sit atop the surfactant molecules, creating an electric field pushing away from the particle that allows for easier release of photoelectrons. In either case, we believe that the loss of the trend as iodide is added can be explained by a film collapse where some sort of coordination is disrupted, causing the ions to sink back into the bulk of the aerosol particle.

Although our research did not provide a definitive answer for why this trend is seen at low concentrations of iodide, I am excited to continue my work during senior research and hope that come May; I’ll have a nice story to tell as I present my senior thesis.
Research Fellow: Kaye Kuphal (2018)  
Concentration: Biochemistry

Faculty Mentor: Codrina Popescu  
Department: Chemistry

Title of Project: Mössbauer Studies of Dual-Function Hemoglobin Dehaloperoxidase from Marine Worm A. ornata

Project Summary:

Dehaloperoxidase (DHP), found in marine worm *A. ornata*, has been shown to have dual function as a hemoglobin and peroxidase. As a hemoglobin, DHP transports oxygen, and as a peroxidase, DHP oxidizes the deleterious halophenols in its environment using hydrogen peroxide as a co-substrate. The active site of DHP contains a heme iron site axially coordinated by a histidine ligand. The flexibility of DHP’s coordination sphere as well as DHP’s binding pocket located above the heme site are ostensible reasons for the multiple functions the protein is able to catalyze. DHP has multiple forms, dependent on pH. $^{57}$Fe-Mossbauer spectroscopy is a technique that probes the electronic properties of an iron ion in a sample by analyzing the nuclear transitions in the $^{57}$Fe in the sample. Thus Mossbauer spectroscopy is eminently suitable to uncover oxidation states and spin states of active sites in iron proteins and novel iron-containing compounds. The goal of this research has been to obtain Mössbauer spectra of a frozen sample of the protein DHP and correlate the parameters with the structural and catalytic characteristics of DHP. Specifically our goal is to analyze the Mossbauer parameters (isomer shifts) and correlate them changes in coordination sphere as a function of pH.

We have determined the low-field Mössbauer isomer shift ($\delta$) and quadrupole splitting ($\Delta E_{Q}$) of DHP by analyzing the spectra at 380 and 700 Gauss at various temperatures in the range of 6 K – 200 K. The spectrum at high temperature (Figure 1) indicates that DHP has two distinct species. DHP Species 1 has $\delta_1=0.35(2)$ mm/s and $\Delta E_{Q1}=-1.80(2)$ mm/s and DHP Species 2 has parameters $\delta_2=0.43(2)$ mm/s and $\Delta E_{Q2}=1.26(2)$ mm/s. We have assigned these two species to the DHP heme center in two states, in which the sixth coordination site (the distal site) is either free or occupied by a water ligand. Because complexes with fewer ligands have smaller isomer shifts, we infer that the Species 1 may be a five-coordinate species and Species 2, six-coordinated.

![Figure 1](image1.png)

Figure SEQ Figure \* ARABIC 2. Mössbauer spectrum of DHP at 700 Gauss parallel field at 6.3 K. Site I has $\delta_1=0.35(2)$ mm/s and $\Delta E_{Q1}=-1.80(2)$ mm/s. Site II has $\delta_2=0.43(2)$ mm/s and $\Delta E_{Q1}=1.26(2)$ mm/s.

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

A challenge higher education institutions face is having the right resources to serve student needs, teaching students that those resources are available, and encouraging students to utilize those resources. This study on information literacy focuses on the metacognitive facet of this challenge, which is the student’s ability to correctly assess how well they can find information and recognize when they need further help. Information literacy is the ability for an individual to know when they need to find information and to evaluate this information effectively and efficiently. Surveys of literature have shown an interesting phenomenon in which peoples’ perceived abilities do not correlate as highly to their actual abilities as one might expect (Ehrlinger et al. 2008). This phenomenon, the “Kruger-Dunning effect”, is illustrated by the finding that those in the bottom-quartile of actual performance overestimate their relative standing, and is consistent with the argument that one must have knowledge in a subject area in order to understand one’s relative strength in that area (Kruger & Dunning, 1999). The Kruger-Dunning effect has been seen in many realms, including debate tournaments, athletics, medicine, and academia, where the lowest performers greatly overestimate their abilities while the highest performers are tend to underestimate their skills (Ehrlinger et al. 2008). This is due to the fact that people are lacking the metacognitive abilities to spot a false answer from a true answer or know if they are accurately evaluating their performance (Ehrlinger et al. 2009).

While information literacy is becoming more and more important in our society, there is strong evidence that suggests that a large portion of students who are entering and even leaving higher education facilities lack information literacy proficiency, yet they believe that they are above average (Gross & Latham, 2007). Gross and Latham (2007) found evidence that of the 51 first-year students they tested at Florida State University participating in a summer session, 45% did not reach information literacy proficiency (Gross & Latham, 2007). They also found that students who had below proficient literacy skills rated themselves as above proficient before and after taking an information literacy test given to them (Gross & Latham, 2007). This shows a similar pattern, dictated by the Kruger-Dunning Effect, in which the bottom performers who demonstrated the greatest deficiency of information literacy skill held the most inflated self assessments and are the least successful in assessing where they are in relation to their peers (Gross & Latham, 2007). It is important to note that after taking an information literacy exam, the below proficient students still did not greatly modify their perceptions of how they did (Gross & Latham, 2012). This shows that after completing the information literacy test the bottom performers still were unaware of their information deficits (Gross & Latham, 2012). Since those with below proficient skills seem unaware of their lack of skills and are overly confident in their abilities, they are then less likely to seek help (Gross & Latham, 2012).

The previous literature details findings from community colleges and state schools. Chosen through a highly selective process, how are students at Colgate, a private liberal arts college, prepared for the information literacy demands they face here, and are they aware of their abilities relative to their peers? How well are they able to recognize and distinguish between what they do and do not know? This study tried to answer this question through giving participants an information literacy test and asking them to judge their relative performance both before and after taking the exam. Preliminary data, some of which was acquired this summer, demonstrate the Kruger-Dunning effect among Colgate students (who score very well relative to national norms), where the lowest performers greatly overestimate their relative standing among their peers at Colgate. This metacognitive error, in which they fail to recognize that they perform poorly relative to their peers, may well keep students from seeking assistance in areas where it would be of benefit. Future work will relate these metacognitive challenges to help seeking behavior, as well as seeking ways to mitigate the errors.
Research Fellow: Soo Bin Kwon (2016)  Concentration(s): Computer Science; Music
Faculty Mentor: Ahmet Ay  Department(s): Biology; Mathematics
Title of Project: Assessment and Prediction of Human Circadian Rhythm

Project Summary:

Circadian clock is a gene expression oscillator that controls the daily rhythm of our body including our sleeping pattern, body temperature, release of hormones and behavior. It is believed that our circadian rhythm is mainly regulated by a network of genes known as “clock genes”. The expression patterns of the clock genes usually correlate positively with our life style. For example, daily expression levels of the clock genes can be used to predict whether someone is a lark or an owl, which can allow us to assist patients with sleeping disorders and rotating shift workers. Recent research in this field has shown that the human circadian rhythm can be predicted from hair follicle cells, which would require test subjects to simply pluck a strand of hair every few hours instead of having their blood drawn out. It has been also suggested that the data collected at three time points is enough to predict the phase of a person’s circadian rhythm quite accurately. This advancement in methodology eased the process of data collection and allowed researchers to have a larger pool of test subjects in their studies.

This summer I worked with Professor Ahmet Ay and Professor Krista Ingram in improving the aforementioned phase prediction method and, creating a new phase and period prediction method for circadian rhythm. Circadian rhythm of an individual can be represented by a cosine curve with its period roughly around 24 hours. In our phase prediction method we first take eight data points (Per3 and Nr1d2 gene expression levels) from each of our training subjects (people with regular daily rhythm) and determine their circadian rhythm by fitting a cosine curve to the data points. From these curves, we create a “standard curve” by taking the average of the curve parameters, which include amplitude, phase, offset, and period. We then collect data from our test subjects at three time points and attempt to determine their circadian rhythm by fitting the standard curve to the three data points. When fitting the cosine curve to the three data points, we fix the amplitude, offset, and period but estimate the phase of the test subject. We use this estimated phase to predict whether the test sample is a lark (oscillation cycle starts earlier in comparison to the normal subjects) or an owl.

We examined the prediction accuracy of this method by varying the time points of data collection. I implemented the method and simulations in MATLAB and tested the method using perturbed synthetic data. Our results showed that it is indeed possible to get a fairly accurate prediction of one’s circadian rhythm, and there were several sets of three time points that guaranteed to give a good prediction. Our results suggested that three-point data collection does not work always and one should collect the data at specific time points to predict the phase of circadian rhythm accurately. We then applied our method to experimental data obtained by the Ingram lab. Our method was able to cluster the given test subjects into larks and owls more accurately than the previous phase prediction method.

Although the method above assumes that phase shift is the only aspect that causes differences in circadian rhythms and that everyone has the same period length, people in fact have different period lengths, which also play a significant role in determining their circadian rhythm. Therefore we developed a second method where we let both phase and period flexible. This method required us to increase the number of data collection from three to four. Our method was able to identify specific data collection times for successful phase and period predictions on synthetic data sets. We could not test this method using actual experimental data, but Professor Ingram plans to incorporate the method into her future research.


Nearly all of an organism’s genetic material is contained in the form of DNA within the nuclei of its cells. Broadly, DNA is more or less a code with instructions for the formation of all of the proteins a cell produces. During a process known as transcription, this genetic code is essentially copied into mRNA, a mobile molecule that can be read by ribosomes in the cytoplasm to produce proteins via a process known as translation. Proteins are responsible for producing an organism’s phenotypes—from their appearance to the metabolic processes occurring within their cells—but their production is entirely dependent upon the formation of mRNA through transcription. Since this transcriptional step is so crucial, molecules known as transcription factors exist to regulate it to ensure appropriate levels of mRNA production. These transcription factors can either increase or decrease transcription of a particular gene, and work by binding to the DNA; however, the nucleus is surrounded by a double membrane that prevents most transcription factors from freely getting inside. Instead, they must be transported through pores in the membrane known as nuclear pore complexes (NPCs) by transport proteins called karyopherins (Kaps). By carrying transcription factors into the nucleus, many Kaps provide an additional level of transcriptional regulation, and thus are able to indirectly impact gene expression levels. While some Kaps are well understood, we still do not know the cargo or function of many of them. With this in mind, this study examines one poorly understood Kap protein in particular—Kap108—that is present in yeast and that has a homolog in humans (the mammalian importin-8 protein), chosen after a genetic screen demonstrated that it was necessary for producing an appropriate response to oxidative stresses.

Microarray data was collected using Agilent two-color chips, each of which had wild-type cells as one sample and kap108Δ cells as another. Four different conditions were considered: normal conditions, 10 min oxidative stress, 60 min oxidative stress, and 60 min oxidative stress followed by 60 min of normal conditions. For each condition, three replicate chips were used, giving a total of 12 chips. Replicate probes on each chip were summarized by taking their geometric mean, and then further background correction and data normalization took place using GeneSpring GX 13.0. Under normal conditions, 74 genes had statistically significant, 1.5 fold or greater differences in gene expression between wild-type and kap108Δ cells as determined by an unpaired t-test (p<0.05). Of these, 35 were underexpressed and Gene Ontology analysis showed that certain functions were overrepresented in this group, including response to oxidative stress. This is supported by the results of the genetic screen that found kap108Δ cells to be sensitive to oxidative stress. Interestingly, 39 genes were overexpressed, and one of the overrepresented functions in this case was cytogamy/cell mating. This suggests that kap108 actually plays a role in facilitating the repression of cell mating, which makes sense given its implicated role in oxidative stress response.

Analysis of data for the oxidative stress conditions revealed that 511 genes exhibited at least a 40% change to differential gene expression between two consecutive conditions (e.g. between 10 min oxid. stress and 60 min oxid. stress). Surprisingly, a majority of genes did not see changes to differential expression until after the oxidative stress was removed, suggesting that changes to differential expression were due to a failure by kap108Δ cells to recover normal gene expression after removal of the stress.
The project focuses on the use of ruthenium-containing compounds that catalyze the chemical storage and release of hydrogen, with an emphasis on two classes of organic compounds: esters and alcohols. In research as well as industrial processes, compounds with the C=O bond are very important in organic synthesis. These bonds usually undergo reduction reactions with hydrogen gas, but current methods generate a large amount of waste, which are harmful to the environment. Thus, there is an increasing need to develop a catalyst that speeds up the reaction, but is used in small quantities to minimize the amount of hazardous waste produced. In addition, gaseous hydrogen must be contained at several hundreds of atmospheres, while liquid hydrogen is only viable at low temperatures. The ruthenium catalyst, however, aids in the chemical storage of hydrogen. It facilitates the reaction between hydrogen and esters to form alcohol as a way to store hydrogen, as well as the reaction of alcohols to form esters and release hydrogen.

\[
\begin{align*}
R'OH & \quad \text{RuCNN-DEA, 4.8\% NaOtBu} \\
0.8\% \text{ toluene, 6 atm, 105\°C, 22h} \\
\end{align*}
\]

The scheme shows the structure of the Ru-complex, abbreviated as RuCNN-DEA, and the conditions used for ester hydrogenation. Multiple substrates were tested, with straight-chain alkyl groups like hexyl hexanoate, aromatic groups like benzyl benzoate and cyclic alkyl groups like ethyl cyclohexanecarboxylate. It was found that the catalysis was efficient for many esters, especially benzyl benzoate, with yields of 95 – 100\%. However, esters containing methyl groups like methyl decanoate were unreactive, with less than 10\% yields. In addition, in a mixture of benzyl benzoate and methyl decanoate, there was a considerable extent of hydrogenation, even though one substrate was a methyl ester.

It was hypothesized that the methanol from hydrogenation deactivated the catalyst and the methanol produced in the ester mixture was quickly sequestered by reacting with another ester, allowing the hydrogenation to proceed. However, a mixture of methanol and esters showed that the methanol concentration stayed constant. In a separate trial, methyl decanoate was mixed with benzyl alcohol in a hydrogenation and gave high yields, which suggests that trans-esterification occurred to produce a more reactive ester. These findings all point to the intrinsic unreactivity of methyl esters.

Currently, the mechanistic pathway of the reaction is being investigated in order to gain a better understanding of the catalysis and rationalize the inactivity of methyl esters.

Source of Support:  
\(\square\) AHUM Div.  \(\square\) NASC Div.  \(\square\) SOSC Div.  \(\square\) UNST Div.  
\(\checkmark\) Other (specify): National Science Foundation
Zebrafish, among some other non-mammalian vertebrates, have the unique ability to regenerate damaged complex tissues. Specifically in the regenerating zebrafish retina, Müller glia cells are responsible for repairing damaged photoreceptors after injury. These Müller glia have the ability to de-differentiate, return to a stem cell-like state, and divide to eventually replace the damaged photoreceptors. Epigenetic regulation, or the heritable, environmental factors that turn genes “on” and “off”, are key to this regeneration process. (Fig. 1) DNA is normally tightly wound around histone proteins. Modifications to these proteins, such as adding methyl or acetyl groups, cause the DNA to “open” or “close” to allow for more or less genetic transcription, respectively. In order for Müller glia to de-differentiate to become stem-cells and re-differentiate to become photoreceptors, they must alter the genetic expression of certain proteins; they must stop making proteins specific for Müller glia, and start making proteins that allow it to be a stem cell, and later a photoreceptor.

In this study, zebrafish epigenetics were manipulated by treating the fish with a histone de-acetylase 1 (HDAC-1) inhibiting drug, Trichostatin A (TSA). This drug causes the zebrafish DNA to de-condense, leading to increased transcription of genes. The drug was added under two different experimental conditions: in one experiment, TSA was added to 12 hour old fish at a concentration of 1.2 µM, and in another experiment, TSA was added to 8 day old fish that were lesioned with UV light.

In the first experiment looking at the effect of epigenetic alteration on the development of the retina, results showed drastic effects. (Fig. 2) Adding TSA to these young fish lead to underdeveloped, completely disorganized retinas. The retinas contained lots of scrambled cells that were non-differentiated. This was shown through the lack of photoreceptor marker, ZPR-1, in the drug condition.

In the second experiment, altering epigenetics of the zebrafish also seemed to have a large effect on the retinal regeneration process. (Fig. 3) Fish were lesioned via 23 minutes of intense UV light exposure, which wiped out the photoreceptor layer of cells at the back of the retina. Then, fish were treated with control conditions (DMSO), or TSA at 2 hours post lesion. Results showed that when TSA was added 2 hours post lesion, the regeneration of photoreceptors was impaired; there was much less proliferation of Müller glia, resulting in weaker regeneration of photoreceptors. Thus, epigenetic regulation also appears to be important to the regeneration process of photoreceptors in the zebrafish retina following light lesion.
Title of Project: The Molecular Structure and Conformations of Isodecalin and 11,11-dichlorotricyclo-undeca-3,8-diene

Project Summary:

We are interested in the molecular structure and conformations of 11,11-dichlorotricyclo-undeca-3,8-diene and isodecalin. We are particularly interested in the geometry of the six-member rings in these two molecules and are investigating them using the technique of gas-phase electron diffraction.

1. Isodecalin
   Isodecalin can be viewed as two fused 1,4-cyclohexadiene. 1,4-Cyclohexadiene was observed to be planar although earlier gas phase structural studies reported a bent structure. Isodecalin is slightly more complicated, since it can be one or a mixture of the following three forms (planar, chair and boat).
   Theoretical MO calculations were performed under B3LYP (6-311G(d,p)) setting. Energy and geometrical values of isodecalin were obtained for the planar, chair and boat forms. These calculations showed that the planar form has the lowest energy, followed by the chair and then the boat form respectively.
   Gas phase electron diffraction data were fitted to least squares models using the boat, chair and planar form. Seven geometrical parameters were needed to define the structures. Preliminary refinements showed that both the chair and planar form models gave equally good agreement to the electron diffraction data. The boat form gave a less satisfactory agreement.
   Since the out-of-plane bending vibrational frequencies of isodecalin are rather low (less than 100 cm⁻¹), the averaged structure of a planar form undergoing low frequency bending motion can have a chair shape. A way to investigate this possibility is to construct a model with a mixture of seven conformations containing various boat, chair and planar forms. The populations of these forms could be calculated from the corresponding energies obtained from theoretical calculations and by applying Boltzmann distribution. Preliminary results gave good agreement with the data and further analyses are needed.

2. 11,11-Dichlorotricyclo-undeca-3,8-diene
   Theoretical calculation was performed under MP2 and B3LYP (6-311G(d,p)) settings. The optimized structures were obtained. The calculations under both settings showed that the six-member rings are planar, which is unusual in that the ring systems are no longer 1,4-cyclohexadiene like.
   Preliminary analyses of the electron diffraction data showed that the six-membered rings are essentially planar in agreement with the theoretical calculations. We are in the process of trying to understand the planarity of these rings.

Title of Project: The Search for Bifunctional Hydrogenation and Dehydrogenation Catalysts Using Earth-Abundant Metals

Project Summary:

Bifunctional hydrogenation and dehydrogenation catalysts have important applications for efficient and environmentally-friendly hydrogen storage. Several catalysts of this type have already been synthesized, but the best of these contain expensive precious metals, such as ruthenium, that are in relatively low abundance in the Earth. By attempting to synthesize similarly effective catalysts, only with first-row transition metals, we can erase the problems of low abundance and high cost for these catalysts.

In order to attempt to create these catalysts, we had to find a suitable model that we could base our attempts off of. Out of the existing effective catalysts, the structure is often a metal center with bonds to a tridentate, or pincer, ligand and two other monodentate spectator ligands, which leaves one open site for hydrogen to be active in hydrogenation and dehydrogenation reactions. Because we are using first-row transition metals, we want to avoid monodentate spectator ligands because they are more labile with these metals. Since the presence of these ligands is important to the function of the catalyst, having them weakly bound to the metal center could cause some serious issues. Because of this, we decided to experiment with a structure that has a metal center with bonds to a pincer ligand and a bidentate ligand, leaving one site of the molecule open for hydrogen to be active in hydrogenation and dehydrogenation reactions. The metals that we decided to experiment with were nickel, manganese, iron, and cobalt. By combining various salts of these metals with different bidentate and pincer ligands in the presence of a base and dioxane solvent, we created a combinatorial library of 48 different compounds to run the same dehydrogenation reaction in situ.

These first dehydrogenation trials were not successful, so we decided to attempt another type of dehydrogenation, this time involving a coupling reaction between 3, 5-dimethylaniline and benzyl alcohol. This reaction yielded some successful results in terms of catalyst activity, the most successful of which was a combination of Ni triflate, the bidentate ligand, diphenylphosphino ethylamine, and the pincer ligand, phenyl pyridine diimine (Ph-PDI). The success of these reactions was measured by the percent conversion of the two starting materials to the imine dehydrogenation product. Through several other attempts to improve this reaction, we determined the following things: toluene was a better solvent than dioxane; potassium tert-butoxide was a better base than sodium tert-butoxide; Ni (II) chloride glyme adduct was a better Ni source than Ni triflate; the best ligand situation was the bidentate ligand, diphenylphosphino ethylamine only, without the presence of the Ph-PDI. On account of this last discovery, we explored the same dehydrogenation coupling reaction with different bidentate phosphine ligands, and we determined that racemic BINAP yielded the highest conversion of starting materials to imine product. The proposed structure of this catalyst is as follows:

We are continuing work on this catalyst, and our next steps are to improve the percent conversion of the starting materials to the imine product and potentially isolate our catalyst as a solid in order to more easily pursue other dehydrogenation reactions in the future.

The goals of this research are to (1) analyze how art, athletics, faith and business can help refugees in Nakivale personally cope with trauma and (2) understand how art, athletics, faith and business are used as platforms for advocacy by refugees in the settlement.

Methodology: For this research, 71 semi-structured individual and group interviews and 8 focus group discussions (FGDs) were conducted between May 22nd and July 2nd 2015. This research design resulted in information being generated from 194 respondents including singers, artists, athletes, religious leaders, entrepreneurs and activists from the Democratic Republic of the Congo (DRC), Somalia, Rwanda, Burundi, Eritrea and Ethiopia. Non-governmental organization (such as Right to Play, the Finnish Refugee Council and Windle Trust Uganda) staff were also interviewed. All data were collected from within the Nakivale Refugee Settlement in the chosen language of the respondent(s), using interpreters. Permission to be conducting research was granted by the Office of the Prime Minister (Government of Uganda) and the purpose of the study, confidentiality and ethical concerns were explained clearly to each respondent, as the interview would only proceed with full voluntary consent.

Themes and Analysis: Involvement in the arts, athletics, faith and/or business can bring the following personal benefits for refugees: (1) a positive use of time; (2) the building of community; and (3) empowerment. (1) Using one's time in healthy ways in the settlement serves several positive functions: creates a distraction, which may help one forget his or her problems and prevent negative past times such as alcohol abuse; brings relaxation and enjoyment and finally builds a sense of stability, if refugees are able to continue occupying themselves in ways they had in their home countries. (2) Community gives refugees a sense of belonging, builds a support system, promotes inclusivity (as most arts, athletics, faith and/or business groups include all genders and nationalities) and leads to sustainability, as these organizations encourage members to teach other skills. (3) Empowerment through these activities and groups comes through refugees being able to:

- contribute to society in a productive manner, earn a small income and build self-reliance, develop skills (life skills, particular coping mechanisms, good values and one's talent), give back and/or serve a higher cause, and finally build upon hope for the future.

The arts, athletics, faith and/or business additionally can also act as platforms to spread awareness: (1) for advocacy surrounding social issues; and (2) for expression of the refugee experience. Causes which groups and individuals work for include promotion of education, prioritization of health (including HIV/AIDS prevention), gender equality (such as ending gender-based violence and sexual gender-based violence), anti-drug and alcohol abuse, anti-discrimination, and peaceful living. Art, athletics, faith and/or business based activities can also help refugees let wider society know about their plight which is personally healing as well beneficial to those being educated.
Project Summary:

My work this summer was a continuation of research done during summer and fall 2014. This project focused on the morphologic variability of the diatom *Eucampia antartica* in four marine sediment cores, LMG13-11 JGC4, LMG13-11JCG6, LMG12-11 JCG1 and LMG12-11 JCG2. The cores were collected from the Hugo Island Trough, located on the western Antarctic Peninsula continental shelf. These data provide insight into regional paleoceanographic change over the past 11,000 years. The comprehensive data set previously included quantitative observations on the ratio of terminal to interior valves, an indicator of winter sea ice extent, and the ratio of symmetric to asymmetric valves, a proxy for iron fertilization of surface ocean waters. This summer I documented the relative abundance of *Eucampia antartica* within each sample. Together these data reveal that from about 11,000 to 5,500 years ago, the western Antarctic Peninsula experienced longer summers, characterized by delayed formation of sea ice during the fall. This is very similar to conditions observed recently in the region. During this extended growing season, blooms of symmetric *Eucampia* initially distinguished the diatom assemblage. However, as the blooms increased in magnitude, the *Eucampia* assemblage switched to a greater proportion of asymmetric specimens, indicative of the importance of iron fertilization. Blooms of asymmetric *Eucampia* are not observed in the polar marine setting today, but are observed downstream of high latitude Southern Ocean islands, where iron fertilization is an important driver of high primary productivity. Developing a model to explain the observed trends and specifically, the precursor increase in *Eucampia antartica* relative abundance before the respective increase in asymmetry will be the next step in this project.

Note the peak of *Eucampia antartica* begins at 320 cm depth in the core. The morphological shift begins later in time, at 170 cm and peaks at 100 cm depth.

Research Fellow:  Dong Mai (2016)
Concentration:  Computer Science

Faculty Mentor:  Ahmet Ay
Department(s):  Biology; Mathematics

Title of Project:   Noise in the segmentation clock network

Project Summary:
In the zebrafish, the paired blocks of mesoderm lying on either side of the neural tube that differentiate into important structures and produce segmentation are called somites. Somitogenesis is the process of forming somites from posterior to anterior in the presomitic mesoderm during early development of the fish, and this process is regulated by a network of genes called the segmentation clock. The purpose of the research was to develop a realistic model of this segmentation clock network, i.e. which genes this network has and how the genes interact with one another.

In the previous summers, Professor Ahmet Ay and his former research students have developed two separate models of the network, one deterministic model and one stochastic model. The deterministic model calculates the concentration levels of species in the network at each time point by using a system of delayed differential equations. The advantage of the deterministic model is that the simulation code runs really fast, but it is unrealistic in the sense that it does not take into account the influence of noise in the system.

The stochastic model solves this problem by using the next reaction method, which probabilistically decides which reaction between the species in the system is going to fire next at each time point. The stochasticity in decision making process introduces the noise to the system. During the research, I updated as well as maintained the existing C++ code base for the stochastic model.

To run the simulation for stochastic model, we needed to find robust parameter sets that would give out realistic results when being used as the input for the simulation. In the past, Professor Ay made use of Stochastic Ranking Evolutionary Strategy (SRES), which mimicked natural selection by recombining elements of good parameter sets to generate a new generation of superior ones. However, the old code for SRES could only be used on deterministic model, so I had to modify the code so that we could use it to do parameter searching on stochastic version.

Another problem was how to assess the accuracy of the model; we tried to do this by matching the noise collected from the result of stochastic simulation with the noise from experimental data. The input from experiments was her1 and her7 mRNA count of every cell from a zebrafish embryo. The cells with higher mRNA level often clustered together to form the blocks that would later become somites when they were pushed to anterior part as the embryo grew. We garnered the noise from experimental data by writing Python code to measure the angle of the somites, slice the whole embryo into numerous thin stripes of that angle, and finally calculate the mean and variance of mRNA level in each stripe.

However, one embryo might contain thousands of cells while the code for stochastic model often took more than 4 hours for a 600-minute simulation of 16 cells. Therefore, it was not practical to run the code on the whole embryo. We tried to work around this by writing Python code to follow a block of 16 cells as it got pushed from the posterior to the anterior of the fish. The block got moved every 10 minutes, and each time it moved, we considered the new position a new stripe. By doing this, we could replicate the whole embryo and collect the mean and variance of several stripes just like the noise data from experimental result. The result we obtained at the end of the summer did not entirely match with experimental data, but it was significantly better than last year after a summer of updating and improving the model.

☐ Other (specify):
The area of Madison County is incredibly rich in history, and this summer's work with the Upstate Institute delved into the local research on two major historical occurrences. John Vincent Atanasoff, recognized as the inventor of the first digital computer, was in fact born in Hamilton, behind the campus on Purdy Hill road. His birth in Hamilton, and eventual graduation from Colgate, place the area as a major location in the development of early computers. Much earlier in local history, Madison County, is rich in Native American and French interaction. Much so that the site of Nichols Pond, located in the town of Fenner just half an hour from Colgate, is the alleged site of Samuel de Champlain's famous siege with the Algonquin against the Iroquois. The significance of this battle lies heavily in colonial French and Native American local history of this area.

My earliest work came in the weeks between the end of May and mid August. I began with Matt Urtz on research for the celebration of John Vincent Atanasoff, involving his son J.A. Atanasoff returning to Hamilton to speak on the matter. I was assigned to research local historical deeds and documents that affirm Purdy Hill Road was the precise location of Atanasoff’s birth. This involved informational work with local historian Jack Loop, and several visits to the Madison County Clerk's office to explore deeds and property indexes. The projected culminated in the presentation of John Vincent Atanasoff in June 6th, where I presented my research and a summary of the Atanasoff’s historical impact.

My next stage of work came with the Town of Hamilton Clerk's office with Ms. Sue Reymers. I primarily worked with town council member Chris Rossi on the Town of Hamilton Comprehensive Plan. This plan is a community vision by the Comprehensive Plan Committee that is designed to set and implement municipal goals to improve local business and preserve the rural and historical character of the area. I familiarized myself with the Comprehensive Plan, attended meetings with the Comprehensive Plan Committee, and developed a Power Point presentation to be used in town meetings open to the public.

While I was working on the Town of Hamilton Comprehensive Plan, I began the second stage of research with Matt Urtz. I started my research on the Battle of Nichols with materials provided by Matt. I researched and documented primary and secondary sources on the Nichols Pond site, and Colgate’s involvement in archaeological investigations. This involved a trip and tour of the actual site in the town of Fenner, as well as a special visit to the Madison County Historical Society. The visit to the site allowed me unique visual perspective in my research and comparison to historical accounts of the site’s topography. At the Madison County Historical society I was allowed special access to primary sources, particularly archaeological reports and articles, as well actual artifacts uncovered at the site. My research will culminate with a presentation of my findings at the 400th Anniversary of Champlain’s Battle in October.

Meanwhile, I continued on with the second stage with the Town of Hamilton Clerk’s office, with the production of press releases, newsletters, and posters. It began with the development of informative materials on the deer issue in Hamilton. I released a newsletter, poster, and several press releases on hunting licenses. I also released similar documents on building permits, dog licenses, and fishing licenses. My work required me to develop article-writing style skills, and comprehensively review and annotate research reports. My work culminated with an informative poster on the deer issue in Hamilton that sits in the Town Clerk’s front window today.
Research Fellow: Katie Mason (2016)  
Concentration: Physics

Faculty Mentor: Kenneth Segall  
Department: Physics and Astronomy

Title of Project: Cryogenic Measurements of Superconducting Josephson Networks

Project Summary:

Simply put, Josephson Junctions (JJs for short) are two plates of superconducting metal separated by a thin insulating layer. Below a given amount of current, the junctions are superconducting because the electron pairs tunnel through the insulator at a fixed rate. If too much current is flowing, electrons will begin to build up causing the junction to enter the resistive state. In the resistive state the junctions display resistive, capacitive, and superconducting behaviors. We can measure solutions to this equation however meaning if we can find other systems and model them with JJs we could potentially solve these systems quickly with the junctions. My project focused specifically on fluxons. Fluxons are pockets of magnetic flux that become trapped in a JJ circuit when it is cooled to the superconducting state. Fluxons can be modeled as pendulums. In this model, each junction is a pendulum that is coupled to the pendulums on either side. Another model is the washboard model in this model, the fluxon sits within a periodic potential well. Each junction represents a well with the fluxon resting in between.

We created devices on a small chip that are shaped like a wheel. Each “spoke” of the wheel contains one JJ. To trap fluxons, we cool down the chip to around .25K. To achieve this we use liquid helium and evaporative cooling. The circuit is superconducting at this temperature. We analyze the I-V curve of the device at different temperatures between .25K and 10K. The standard deviation of these curves with respect to the log of temperature is displayed below. When the line is straight it means that quantum tunneling was taking place over the Josephson junctions.

In our devices, there are nine places for fluxon to get trapped as we lower the temperature. In future experiments we hope to control where the fluxon is trapped by altering the size of the JJs on the different spokes. We are in the process of using a computer program to simulate where the fluxons are trapped for different sized junctions and will use this information to create a device where we can predict the location of the fluxon.

Research Fellow: Lindsay McCulloch (2016)  Concentration(s):  Environmental Biology; Geography  
Faculty Mentor: Michael Loranty  Department: Geography  

Title of Project:  Vegetation Impacts on Permafrost  

Project Summary:  

High-latitude ecosystems are important sinks, as well as potentially large sources of carbon as the climate continues to change. Belowground biomass of vegetation can act as both a sink and source of carbon; with live root biomass acting as a sink of carbon stores, and dead root biomass acting as a source of carbon to the atmosphere. There is significant literature citing the large ratio of belowground to aboveground biomass in tundra ecosystems, yet understanding of allocation in forested regions of the artic is less understood. Arctic vegetation is investing more resources and energy into belowground biomass relative to aboveground biomass compared to other ecosystems. However, permafrost ecosystems have low decomposition rates as a result of their cold and saturated soils. This allows for the accumulation of a thick organic layer mainly composed of decomposing belowground biomass. The ratio of living aboveground biomass to belowground biomass could be skewed since often the differentiation between live and dead roots is often not made.

To quantify the ratio of live to dead roots in tundra and boreal forest ecosystems, soils were collected along a latitudinal gradient throughout Interior Alaska, the Arctic North Slope and Coastal Western Alaska. Several sites located in close proximity were chosen to control for geological and climatic differences among sites, allowing differences to be attributed to the proximal ecosystem. Soil samples were washed, sieved and the roots were sorted into the four categories, including fine-live, fine-dead, coarse-live, and coarse-dead. Classification of these roots followed well established protocols based on visual and physical cues with coarse roots being greater than 2mm. Dead to live ratios of root biomass varied from 4.91 to 45.98, averaging at 14.29 +/- 11.39. Belowground allocation of plant biomass and associated resources may not be significantly larger than aboveground allocation because the majority of the belowground biomass is dead and non-functioning. As global temperatures continue to increase so will decomposition rates, allowing the carbon stored in these dead roots to be released into the environment creating a potentially large carbon source.

Source of Support:  

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

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Title of Project: The impact of in-stream and whole drainage basin lime applications as a mitigation strategy for counteracting the effects of acid deposition on stream ecosystem structure and function

Project Summary:

Our research was a continuation of a longitudinal study examining the chemistry, diversity, and overall health of 5 streams draining into Honnedaga Lake in the Adirondack Mountains. This involved a combination of both lab work and field work, and required weekly trips to our sites for various experiments and sample collections. We studied 5 streams, T6, T8D, T8U, T9, T16, and T24, that were either chronically acidic, episodically acidic or neutral to examine the effects of lime application on the water chemistry, microbial respiration, macroinvertebrate biodiversity, and leaf decomposition. The sites that were limed include T6, T8D, and T16, and each one has a reference stream with a similar initial pH. Using nutrient uptake experiments, we aimed to identify differences in PO4 and NH3 uptake between streams in order to assess the health of the stream ecosystems. Due to abnormally high levels of rainfall and subsequently discharge in the streams, we were unable to carry out this portion of the experiment. In order to examine steam biodiversity and microbial respiration, we placed leaf packs in each stream for a 5 week period. These packs were composed of 3 grams of red maple (Acer rubrum) leaves placed in mesh bags and then anchored to the bottom of the streams using bricks. After 5 weeks, we retrieved the bags and analyzed leaf mass loss and microbial respiration rates. The results showed a significant difference in microbial respiration, but not leaf mass lost, between the chronically acidified control and lime-treated (experimental) streams. Additionally, we aimed to isolate, count, and classify the macroinvertebrates from each leaf pack to examine the relative biodiversity levels between streams. This portion of the study is still being completed, but we hope that the results might bring new findings and information about the success of the liming efforts. This experiment is currently ongoing, but a clearer picture of the long-term effects of both in-stream and whole drainage basin lime application is being followed.
Title of Project: Volcanic Evolution in the Galapagos: The Geochemistry and Petrology of Espanola Island

Project Summary:

This research project was a combination of fieldwork in the Galapagos Islands and lab work at Colgate University that was focused on establishing the geochemical origin and evolution of Espanola Island of the southeastern Galapagos. Myself and another student accompanied professor Karen Harpp to the Galapagos Islands for three weeks of fieldwork collecting samples and data from Espanola and also Fernandina Island. Samples were then brought back to Colgate University and are still being processed using a variety of techniques in the lab. It is intended that the results of this work will be presented at a conference later in the academic year.

The Galapagos Archipelago consists of a series of volcanic islands located ~1,000 km west of South America, and are thought to be the result of a mantle plume. The southeasternmost island of Espanola is one of the smallest of the major islands, measuring only 7 by 14 km and reaching an elevation of 200 m. Espanola is also the oldest island in the chain, with K-Ar dates from 3.01 ± 0.11 to 3.31 ± 0.36 million years (Hall et al. 1983; White et al., 1993). The southern coast is defined by cliffs that exceed 100 m in height, made up of nearly flat-lying lavas that are each several meters thick. The northern coastline consists of lavas that dip gently toward the ocean from the highlands, as well as remnants of eroded cinder cones. Paleomagnetic measurements made in the field indicate that the western half of the island is reversely polarized, whereas most lavas measured across the eastern half are normally polarized. Major element analyses of samples from across the island indicate that fractional crystallization is a dominant process controlling chemical variations in Espanola lavas, suggesting a relatively long-lived magmatic plumbing system. Stratigraphically constrained chemical variations suggest the magma chamber may have experienced periodic replenishment with compositionally homogeneous primitive melts. Variable fluid-mobile trace element concentrations provide some evidence for contributions from ancient, recycled oceanic crust to the parental melts. Espanola lavas have more depleted Sr and Pb radiogenic isotope ratios than either Floreana or Fernandina Island, and lie on a mixing curve between the composition of the plume and the depleted upper mantle. Between ~3 and 8 Ma, the Galapagos Spreading Center was closer to the Galapagos plume than it is today. Given that Espanola was being constructed during this same period, the depleted isotopic signatures suggest that plume-ridge interaction may have been a strong influence on the island’s geochemical composition.
Research Fellow:  Anna McHugh (2017)  
Concentration:  Environmental Biology

Faculty Mentor:  Julie Dudrick  
Department:  Update Institute

Title of Project:  Field School Fellow with Chenango Canal Association and Southern Madison Heritage Trust

Project Summary:

Madison County is home to a variety of recreational trails open to the public. Trails in the United States began as hunting and transportation paths for Native American tribes. Walking for pleasure is the most popular outdoor recreation activity in the United States. Local trails continue to be ideal areas because of the diversity and suitability for many different activities and experiences. The Chenango Canal Association and Southern Madison Heritage Trust aim to protect, preserve, maintain, and improve local trails and reserves. This summer research focused on promoting the newest addition to SMHT’s property, the Gateway Reserve, as well as maintaining trails such as the Chenango Canal Towpath.

Early trails became migration systems for explorers and pioneers and were eventually integrated into the road and highway system. The earliest recreational trails were foot paths from nineteenth-century guides to the summits of New England peaks. Today, the trail system in the United States is comprised of over 60,000 miles in all 50 states. Recreational trail walking can improve health through fitness and relaxation and also provides an outlet to experience and enjoy natural, historical, and cultural sites.

The Gateway Reserve, acquired in 2014 by SMHT, is a 4 acre property that provides access to a hiking trail along the historic Madison Feeder. This trail passes alongside the wetlands of the Gateway Reserve as well as beautiful ponds. Southern Madison Heritage Trust (SMHT) is an all-volunteer land trust that protects land in a manner the previous owner wishes to see. SMHT can own land or hold a protective easement, which is a legal document describing the specific activities that are allowed on the property, for example, farming, or open space or an educational reserve open to the public. The land trust is bound by the agreement forever. Should the land trust cease to exist, the agreement responsibilities would be transferred to another similar organization which would be required to abide by the conditions of the easement.

The Chenango Canal Association has a mission to protect, develop and maintain the five-mile summit of the original towpath trail and the canal for the public’s enjoyment for fishing and as a walking and mountain bike trail. In 1834, as many as 500 men stayed in each area, hand-digging the 2.5 million dollar, 97-mile Chenango Canal project. The Chenango Canal was unique in that it was the first in America to be fed entirely from a system of rain and spring fed reservoirs. In 1878, the Canal closed after 41 years due to loss of revenue and the creation of the railroad but now remains as an accessible trail open to the public.

Source of Support:  

☑ AHUM Div.  ☐ NASC Div.  ☐ SOSC Div.  ☐ UNST Div.  ☑ Other (specify):  Upstate Institute
The labor of enslaved peoples throughout the United States stands as one of the most significant factors in the development of both our national identity and the very physical structures that comprise our nation. Accounts of slavery and its effects have resonated throughout history, serving as catalysts and focal points for social, political, and economic change. However, at times the direct human costs associated with these large scale effects can be lost, along with the stories and personal narratives of those who lay in bondage. All too often secondary and tertiary analyses gloss over the painful and sometimes disconcerting testimony of those who lived in slavery and the harrowing accounts of what happened to those who managed to resist. My research focused on the archives of the Federal Writer’s Project in an effort to locate and reveal the direct and personal testimony of those who fought and died to free themselves from slavery.

The research began with a comprehensive survey of the microfilm records of the Federal Writer’s Project which contained nearly ten thousand pages of interviews of former slaves and their kin. The records were originally compiled from 1936-1938, so only the oldest of the former slaves remain, however their words still reveal a rich and illuminating testimony. While many of the subjects used the opportunity to reminisce about their childhoods in bondage, many more distinctly recalled acts of resistance. These included all manner of behavior from minor evasion of labor through temporary flight, to armed confrontations with pursuers when more serious attempts at escape were made. These cases were then compiled into a record of several hundred individuals who either observed or were a part of an escape attempt.

The data from these cases, when combined with the concurrent research of Anne Canning into the backgrounds and records of lesser known abolitionists and members of the United States Colored Troops (USCT) within the Union Army, serves to provide a more complete picture of the lives of those most affected by slavery and their attempts to expunge its stain. I concluded my research by examining newspaper records of notices, police reports, and advertisements concerning escaped slaves. This additional information served to further develop the narratives of the former slaves’ lives, which had often concluded after their escape or liberation.

The research I completed under Professor Hodges and the guidance he provided has given me a much broader and more nuanced understanding of the personal experiences and motivations of enslaved peoples, both those who attempted to escape their bondage and those who decided to remain behind. The compilation of all of this data into a centrally indexed, summarized, and analyzed report will serve to inform future work on the subject and provide a basis for attempts to theorize the causes of differing levels of abuse by region and of the individuals’ decisions to attempt escape, amongst a variety of other questions. The experience of reading these accounts has been humbling and personally transformative and I hope that my work will be useful to Professor Hodges’ research and that of others with similar interests.
Research Fellow: Yizhou Mi (2017)  
Concentration: Mathematics

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

Title of Project: Five Centuries of Orientalism on China: An Anthology with a Critical Overview

Project Summary:
Research started very early at where both professor and I noticed that many of the western philosophers of the nineteenth and the twentieth century maintained “China was stagnant”. Such an unusual phenomenon rendered us to ponder questions: What was the image of China really like in western academia? What were deeper reasons behind it? What did this image mean to the west no matter it was a positive image or a negative one? All those questions will be answered in professor’s anthology.

To see the symbol of China in Western works, I traced where “China” including its synonyms appeared and analyzed contexts as well as authors’ intention of illustrating them. In order to thoroughly understand the ideology of western philosophy and all ideas that once significantly contributed to the human history, we perused the *Columbia History of the Western Philosophy* and the *Main Currents of Western Thoughts*, books that contain a complete introduction to the development of western philosophy with succinct explanations.

Professor carefully read through these books and took notes with a pencil during the day in such a way that undisturbed her mind flow. In the morning I helped her to compile all her notes into electronic form and typed page numbers, title, and content, for her convenience of checking afterwards. Also, I helped her to look up some technical terms she did not fully understand when she read, such as “natural theology”, “natural philosophy” and etc.

Sometimes professor assigned me to read several books or chapters of secondary resources, such as *The Worldly Philosophers* and take note of main idea or crucial concepts. Such a task not only made professor judge quickly whether a book was worth reading for her, but also trained my ability of speed-reading and gist grasping within a limited amount of time.

After both of us read certain works, we usually introduced to each other initatively the viewpoints that are valuable and worth spreading and discuss altogether. Professor emphasized critical thinking skills very often. For example, when we broached the viewpoint of thinking China as a symbol of conservatism, we referred to John Dewey’s viewpoint of China being conservative on natural resources… Professor pointed out that the importance here was not ought to take his view of conservatism as granted and use this implausible truth to interpret certain China’s phenomena, but to try to figure out the logic behind the theory of conservative China and to attempt to challenge its assumption.

Certainly research progress could not always be very smooth, sometimes may encounter some irradicable problems. For instance, once we attempted to search for English translation of Schelling’s discussion on China, which was published in a Chinese book excerpting from Schelling’s work *The Philosophy of Theology*. I searched on Google, borrowed all related books from all possible sources, connectNY as well as WorldCat, and even turned page after page to look for any similarities but failed. I went to ask a librarian for help at last but ended with no progress at all. We had no choice but left the problem there.

This research not only allowed me to have the honor to deeply know that my professor was more like a good friend, but also to obtain real academic research skills which undoubtedly render my future life and study less stumbled.

Two core books of this summer research project

□ Other (specify):  

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"Two core books of this summer research project"
Title of Project: The Credits

Project Summary:

This summer I researched and collected all types of feature-length film in order to facilitate a video art project about credits in movies. A few of my tasks included gathering DVDs from every decade starting in 1910 and ending in 2010 (I acquired all of the movies from the Colgate library), ripping the credits from said films, and researching the culture of Hollywood, unions, and the history of credits.

One of the smaller side projects consisted of collecting several films that listed Edith Head as the costume designer in the opening credits. The “myth”, or story, that follows Edith is that she possibly did not use her own sketches in the interview to get her job, which allowed her to work for over 30 films and win a handful of awards. Her extremely successful career has a tint of mystery to it.

Another side project was collecting Universal Studios films about monsters (Frankenstein, The Mummy, etc.) because their credits shared a similarity. The movies displayed the actors’ names both in the opening and closing credits. And before the closing credits, the text read, “A Good Cast is Worth Repeating”. This is a little-known treasure of these films. I ripped the footage for all of the films that had it.

Another side project for this project was researching and downloading footage of famous Allen Smithee movies. The name Allen Smithee was used as a pseudonym for when directors were not satisfied with the final product and wanted to take their name off of the credits. In most cases, the directors felt as if the studios withheld creative power, thus prohibiting them from expressing their true artistic idea for the film.

The main idea of these side projects was to categorize certain films into some groups and then studying the credits within these groups. There is such a wide variety of movies, it is more efficient and organized to look at them within groups.

Through this project, I learned about credits in a way I never thought I would. I had no idea how much work and consideration was put into the paratext, the material surrounding the context (for example: opening and closing credits, covers, etc.). Many people and legalities must be considered (studios, unions, etc.). Another part of the filmmaking industry was revealed through this research- and that is the importance of artists’ voices. There is the objective and legal element to filmmaking, as well as the significance of personal and artistic integrity that anyone with a camera possesses.
After data has been obtained and processed, the next step in research is to analyze it, which involves graphing various plots in order to determine specific relationships. These tell us about the physical processes that occur; depending on what information is graphed. The most tedious part of any data analysis project is the creation of graph after graph. While we could spend hours making each individual graph, it made more sense to create an interactive program that does all of that work automatically. Using python 2.7, its plotting module MatPlotLib, and the Graphical User Interface (GUI) module Tkinter, that idea came to fruition (mostly). The user is led through several steps of importing the CSV data file, converting magnitude data to flux or vice versa. The user will also identify and create other columns for the plotting functions. The final result is two main plot windows, one with light curves and one with other useful graphs. In the graph windows, the user can switch between various wavelengths to customize what is seen. While the project is far from being completely debugged and there are numerous safety nets that need to be put in place, the program is functional. It cuts down the time from a few hours of making graphs to a few minutes of selecting inputs.

Figure: One of the Graphical User Interface (GUI) pages used to graph blazar variability data.

☒ Other (specify): NASA / New York Space Grant
Title of Project: Domestic Disturbance: An Evaluation of Police Militarization in America

Project Summary:

Domestic Disturbance is an analysis of recent militarization of policing forces in America. The project was inspired by concerns over militarization and police brutality in the aftermath of incidents in Ferguson and Baltimore. For the project, militarization was defined in two ways: using military or military-trained units to perform the tasks of civilian police and the practice of civilian police units adopting training, tactics, and equipment primarily used by military forces. The project largely focused on how the American government has been funding or otherwise assisting in the trend of such militarization. The Community Oriented Policing Services (COPS) program, Byrne Justice Assistance Grants (JAG), and Defense Department Program 1033, were the three federal programs at the center of the research. Data and figures for the project came from a variety of sources, including a Congressional hearing and raw data released by the Pentagon on Program 1033. In its final form, the project became a short video, under twenty minutes that was uploaded to YouTube under the name “Domestic Disturbance.”

Introductory works on the subject of militarization included Radley Balko’s *Rise of the Warrior Cop* and news articles and Dr. Peter B. Kraska’s assorted publications on the subject. These works provided a guide as the project was assembled, and so were included in the introduction to the video. Following this introduction, wherein relevant terms were defined and a basic background of popular and academic concerns over militarization was provided, a discussion of direct militarization, the process in which the military performs the role of police, began. The number of Special Weapons and Tactics (SWAT) teams appears to be on the rise as does the use of forces like Marines, Coast Guard, National Guardsmen, and other members of the military branches to patrol areas and make arrests within the borders of the United States. Even federal departments and agencies have utilized SWAT teams. Perhaps most surprising in this regard is that NASA maintains its very own SWAT team.

The final section of the project detailed indirect militarization, in which the federal government provided funding for police to adopt practices and equipment commonly utilized by the military. The three programs detailed in the final project were chosen for their large role in the militarization of American police but were also chosen for their relative transparency when compared to other grant programs that did not keep records of how federal money was being spent. COPS is a grant program from the Department of Justice that was initially intended to hire police officers that would be a positive presence in the community, but the funding can be used to hire SWAT teams, and there is evidence that this commonly happens. Once the money is in the hands of the police department, it is up to their discretion how the money is spent and the federal government provides little to no oversight. The Byrne JAG program is actually a combination of two programs that provide funding to police departments using a complex formula in which every state receives funding and local police forces can also apply for grants. The spending here is almost entirely up to the police as well, meaning the government does not have accurate records of where the money went. The most direct link to militarization comes from the DOD 1033 Program. This program allows police departments to request military surplus from the Pentagon and the equipment is then transferred to them for free. Departments can request anything from helicopters to office supplies. This program also provides equipment to school police and federal agencies. These programs are still in operation today, though 1033 has been scaled back so grenade launchers and tanks are among items no longer available to local police forces. The project concluded with an acknowledgement that though these programs make police safer, they create an atmosphere that makes citizens feel unsafe. The project is intended to be a starting point for citizens to inform themselves about a serious political and social issue in America.
Research Fellow: Chi Nguyen (2018)  
Concentration: Undeclared

Faculty Mentor: Julie Dudrick  
Department: Upstate Institute

Title of Project: Field School Fellow with the Chenango United Way

Project Summary:

This summer, I interned with the Chenango United Way in Norwich as a Field School Fellow of the Colgate Upstate Institute. Chenango United Way is a non-profit organization which, through annual fundraising, distributes funding through Request for Proposal (RFP) application process to other non-profit agencies and programs that serve the community in three different aspects: Education, Health and Income. My responsibility during the summer internship is to conduct Mid Year Site Visits to agencies and programs that receive funding from Chenango United Way, to review the budget spending, accomplishments and challenges with program runners and offer suggestions for improvements of the programs themselves and of future RFP applications.

I was able to schedule appointments and meet with 22 different program runners, and learn what impacts non-profit programs can bring to the community, as well as what challenges non-profit organizations face in delivering and advancing their missions and visions. The lack of funding and resources is one of the major difficulties that lead to decrease in spending towards marketing and advertising the programs to both volunteers helping in delivering services, and to in-need populations that would be potential clients. As a result, some of the programs struggled to meet their mid year projected outputs and outcomes, due to the inability to attract enough volunteers to help or clients to serve.

On the other hand, most programs are able to deliver their projected outputs and outcomes, and even exceed the proposed numbers. All programs contribute significantly to the advancement of the Chenango County living standard, whether in Education, Health or Income aspects. Clients served are able to live more sustainably, stably and meet basic needs that would help improve quality of living in the future, such as housing stabilization, transportation to medical services and so on. Collaborations between programs receiving funding, and with other non-profit agencies in the region, are also a great demonstration of how non-profit programs can overcome their lack of resources together by extending connections that help avoid duplication of services, and advancing the ultimate impacts of all programs involved.

I was able to learn a lot about how non-profit agencies work as well as how to evaluate and craft a good RFP application, which are skills that would definitely be necessary in my future career path towards working for international non-profit organizations in public health services.

Source of Support:  
☐ AHUM Div.  ☐ NASC Div.  ☐ SOSC Div.  ☐ UNST Div.  
☒ Other (specify): Upstate Institute
The primary goal of these projects is to apply computational chemistry techniques to understand various reaction mechanisms in inorganic chemistry. This involves mapping out stationary points (intermediates) and first-degree saddle points (transition states) on the potential energy surface for a given chemical reaction. The reaction in focus is the insertion of oxygen into a Platinum complex. This is an important reaction with interesting radical chemistry and potential applications in solar fuel production. Three major possible pathways have been proposed based on results in the literature and data from experimental collaborators.

Molecular models were built in the computer cluster using Gaussian 09 in order to facilitate the computation of energy and other relevant parameters. The models were then modified and updated before being sent to the server Kabuki to find the energy of different possible structures. For each molecule built three types of calculation were conducted: frequency calculation, stability calculation and solvation calculation. Data from these calculations were gathered into a spreadsheet to help determine the feasibility of each reaction pathway. At the end of the project most of the most important information about individual molecules had been gathered and completed. After individual molecular calculations were completed additional steps were taken to determine the possible transition states between these species. The determination of the transition state is a crucial step in deciding whether a reaction pathway is likely to occur. Some transition states in the project were quickly located while others were more difficult to optimize due to the problems with initial guess structures. Further steps are needed to be taken in order to obtain complete transition state calculations as well as mapping out the most feasible mechanistic pathways for this reaction.
Over the summer I was given the opportunity to go to Alaska to work on a research project with one of my professors. This project is designed to look at the vegetation in northern Alaska as well as the permafrost layer and try to find a correlation of some kind. To do this, sites were selected in various locations and terrestrial surveys as well as took data from the boreholes were taken at each site. The terrestrial surveys consisted of gathering data about the vegetation in the area as well as taking soil samples and measuring the depth of the soil before the permafrost, permanently frozen soil, started. Data from the boreholes was collected by one of the principal investigators, Alexander Kholodov, who is a researcher and faculty member at University of Alaska Fairbanks.

Throughout the summer, Fairbanks served as a home-base for the team while we traveled to various locations around the state. Starting on the campus of University of Alaska Fairbanks, our team worked in sites consisting of forests and tussocks. We then proceeded to move north of the Brooks Range and worked out of Toolik Research Station on tundra sites. These sites varied from the ones in Fairbanks primarily in latitude and gave much insight into how changes in this variable affected not only the species of flora found but also the active layer, the unfrozen part of the soil. After returning to Fairbanks, the team flew to Nome which is located on the western edge of Alaska on the Seward Peninsula. This location allowed for the opportunity to observe how longitudinal variance affects terrestrial ecosystems. Nome was also a good location because there are no physical deterrents to stop the movement of the tree line. In comparison, the Brooks Range affects the movement of the tree line north. After returning to Fairbanks, the team traveled south to work on sites closer to Healy and Denali National Park.

The two different types of work done over the summer can be divided into the categories of fieldwork and lab work. For each site, fieldwork took between two and four hours. Three 20-meter-long transects were set up at each site, all parallel to each other and 14 meters apart. At each of these transects, various soil and vegetation measurements and samples were taken. Measurements consisted of recording tree diameters, percentage of canopy and understory cover, amount woody debris, biomass distribution, and active and organic layer depths. Biomass samples comprised of deciduous and evergreen shrubs, herbaceous material, moss, and lichen were collected at meter zero on each transect. Soil samples of the organic and mineral layers were also collected at zero meter but also at the 20 meters’ mark at the far end of each transect.

Lab work for a site was typically started the next day and consisted of working with the soil samples taken as well as working with the biomass collected. The biomass was put into a drying oven and left in for two days to remove the moisture. The biomass was then removed and massed. It was then packaged into subsamples that were sent to Woods Hole Research Center to have carbon and nitrogen testing done. Soil samples took a longer time to process as they needed to be massed and have any coarse roots, defined as roots greater than 2mm, sorted out. These roots were then massed separately so as to determine how much of the original mass had come from them. The soil samples were then individually homogenized and subsampled into a weigh boat and a metal tin. The plastic weigh boat was only put in the drying oven before it was massed and sent to Woods Hole Research Center to get carbon and nitrogen testing done, just like the biomass. The sample in the metal tin was put through the additional procedure of going into a muffle furnace after being dried to burn out any organic matter. The purpose of putting the samples in the drying oven was to determine how much of the mass came from moisture. Putting the soil samples into the muffle furnace allowed one to know how much organic content composed the soil of that site compared to inorganic material.
Title of Project: Klf4 null MEFs exhibit increased Rho-mediated stress fiber formation associated with migration

Project Summary:

Cell migration is common in development, wound healing, in normal immune response, but can also occur abnormally in cancerous cells. In the body, cancerous cells that migrate from one tissue to another are dangerous. This process is referred to as metastasis. The mechanism behind the development of metastasis is complex and highly regulated. Investigating metastasis within in vivo is challenging. This summer, research was conducted on the process of migration and invasion in vitro. This was performed by analyzing the increased migration of fibroblast cells isolated from mice that were either wildtype or missing Klf4 from their genome. Using techniques such as western blotting, fluorescent staining, and migration assays, we were able to conclude that cells missing Klf4 experienced increased migration through the increased expression of Rho—a protein responsible for altering the cytoskeleton of the cell in order to favor movement.

Because KLF4 is commonly mutated in cancers, our research focused on the downstream effects of KLF4 knockout within MEFs. Based on previous lab research, it was known that MEFs null for KLF4 migrated at significantly faster rates than wildtype MEFs. We first stained MEFs with phalloidin in order to visualize the structures of actin in the null compared to the wildtype. It was revealed that Klf4 null MEFs exhibited higher expression of actin structures associated with migration, including: filopodia, lamellipodia, and thin stress fibers.

The literature suggests that such actin migration structures are regulated by the expression of Rho through the PI3K/AKT pathway. Similarly, previous mRNA data compiled by Dr. Hagos suggests that Rho expression at an mRNA level is upregulated in Klf4 null cells. This was then confirmed through western blotting during the summer, showing that Klf4 null cells expressed Rho at a fold change of 2.5. This indicates that Rho is a potential downstream cause of increased MEF migration when null for Klf4. In order to further validate these results, MEFs were treated with Ly-29, a drug that affects the expression of Rho upstream in the PI3K/AKT pathway. This resulted in a downregulation of Rho expression and stress fiber formation. Cells were also treated with Y-27632, a repressor of Rho expression. This resulted in decreased Rho expression and decreased migratory actin structures.

Aside from investigating the PIK3/AKT pathway responsible for Rho expression, we also investigated the upregulation of MMP3, an enzyme responsible for the degradation of basal membrane proteins. To do so, cells were treated with SB-505124, a drug that competitively inhibits TGF-beta from interacting with its ligand. This does not allow for the activation of MMP3. When treated, Klf4 null cells did not express high stress fiber formation.

Future research on KLF4 mediated cell migration and invasion should begin with invasion. In order to do this, MEFs null for Klf4 should be exposed to invasion assays containing collagen basement membranes that mimic the complex process of invasion. Also, working with nude mice and investigating whether injections of Klf4 null cells would create tumor and whether those tumors would metastasis is a future direction that holds much promise.

Title of Project: Photochemical pathways to the production of secondary organic aerosols

Project Summary:

Aerosol particles play an important role in the atmosphere. They affect the Earth’s radiation budget through scattering of radiation and serve as cloud condensation nuclei. Further, they provide sinks for semi volatile components of the atmosphere. Lastly, aerosol particles play host to a wide range of chemical reactions that alter the composition of the atmosphere. The role of these particles is poorly understood although they play an important role in direct climate forcing through scattering and absorption and indirect climate forcing through the hydrological cycle.

The experiment was set up as shown in Figure 1.

We produce an atmospheric pressure flow of aerosol particles created from an aqueous solution of NH4NO3 and sodium anthraquinone sulfonate (SAS). An atomizer produces a dense stream of droplets which we dry by passing them through a desiccant-containing diffusion dryer and are size-selected by a differential mobility analyzer (DMA) prior to analysis. We generate an RH-controlled flow by mixing dry air with air that has been saturated with water vapor using a Nafion membrane. In the ionization cell, a 355-nm laser excites the SAS, creating the triplet state through internal conversion. Another, 230-nm laser selectively ionizes the excited triplet SAS. The aerosols then carry a net positive charge. We monitor this charge using an electrometer while scanning the delay between the lasers. The figure shows a schematic diagram of the experimental approach. For the first part of the experiment we vary the RH and measure the ionization signal. In the second part, we added varying concentrations of succinic acid (a potential reaction partner) to our aqueous solution at a fixed RH (50%) and measured the ionization signal.

Results

- Higher RH reduces lifetime either by changing the charge state of the photosensitizer (weak base) or enhancing diffusion controlled reactions
- Higher succinic acid reduces lifetimes. We do not yet know the reason why but we will conduct further experiments and research into that area.

Our experiment is the first to monitor directly the lifetime of electronically excited triplets in aerosol. These measurements will help elucidate the components and conditions that promote photochemical SOA formation. These experiments show excited triplets have sufficient lifetime for heterogeneous reaction, but the lifetime is very sensitive to RH. If natural aerosol contains abundant quenchers, then reaction with VOCs is less likely when the RH is high. The reaction with succinic acid is only a demonstration. Other reaction pair are likely to produce faster chemistry, and future experiments will address these possibilities.
Research Fellow: Jessica O’Malley (2017)  
Concentration: Physics  

Faculty Mentor: Rebecca Metzler  
Department: Physics and Astronomy  

Title of Project: Exploring the correlation between atomic disorder and microhardness in barnacle exoskeletons  

Project Summary:  

Barnacles are unique arthropods that secrete material to form an exoskeleton for protection. The exoskeleton includes a side plate, base plate, and operculum consisting of calcite crystals. Unlike geologic calcite, the different components of the exoskeleton exhibit a great deal of atomic disorder and, on a larger scale, the crystals within the exoskeleton are not all co-oriented. The goal of my project was to test the effect of crystal orientation and atomic disorder on the hardness value of the barnacle exoskeleton.  

Multiple different techniques were used to gather data. XANES spectroscopy was used to test for the elements present in the barnacle exoskeleton. In order to perform XANES spectroscopy, my lab group went to the Canadian Light Source in Saskatoon, Canada for a week. To examine crystal orientation and hardness values I micro-indentated and imaged samples of *Balanus amphitrite*. To examine atomic disorder, I made infrared (IR) spectroscopy grinding curves of the side plate, base plate, and operculum of barnacle samples.  

The initial results of these tests showed that on average the side plate is harder than the operculum, no matter the crystal orientation of the sample. Also, the operculum has the greatest atomic disorder, followed by the baseplate, and side plate. Further study will show whether there is a correlation between atomic disorder, crystal orientation and hardness value.  

Currently, my research is being expanded upon, in order to try to relate the atomic disorder, crystal orientation and hardness value of different types of barnacles. Overall, my research contributed to a much bigger project that will give insight into the formation of barnacle exoskeletons.  

Source of Support:  
- AHUM Div.  
- NASC Div.  
- SOSC Div.  
- UNST Div.  
- Other (specify): Justus ’43 and Jayne Schlichting Student Research Fund
This summer I worked with the Lake Moraine Association on a variety of projects. My major focus was designing and directing a stewardship program to educate boaters about Aquatic Invasive Species (AIS). This involved recruiting volunteers to work at the local boat launch, teaching the volunteers how to use the program that has been developed, finding an efficient way to collect and record data, setting up a volunteer scheduling system, and spending time at the launch myself, educating boaters about the importance of preventing AIS transmission. By the end of summer we established a sustainable stewardship and training a small core group of reliable volunteers to protect Lake Moraine.

In order to accomplish all the tasks that we wanted to achieve this summer, I had to figure out the best method to develop a sustainable and successful stewardship program. In order to do this I needed to recruit reliable volunteers that were willing to consistently volunteer their time. This was the biggest barrier of my summer internship. I found that a lot of people were in favor of the program, but didn't have the time to contribute.

Another key to having a successful program is to attract the right type of volunteers. You cannot just have anyone do this job, but rather, they must share in the common core values of educating boaters about the importance of Aquatic Invasive Species transmission. The next step is to develop an efficient way to collect the data that you want. For us, we decided to use a survey that was both easy for the boaters and volunteers asking the questions. This survey was developed in conjunction with Paul Smiths College and was tailored to the aspects and goals of Lake Moraine. To accomplish this, we used iPads to make recording the answers very simple and having them all in one location electronically saved. Finally, it was extremely important to make sure that boaters were continuously getting educated about this issue. To do this a number of methods were used. I created a brochure that informed boaters about the lakes around Lake Moraine as well as the types of aquatic invasive species those lakes had. When comparing the lakes, Lake Moraine was not nearly as infected as other lakes with aquatic invasive species. This brochure allowed for boaters to know what type of species lived in the waters that they were about to put their boat in as well as how to drain, clean, and dry their boats properly. Also, a sign was developed and installed near the boat launch that has pictures of common aquatic invasive species and again how to drain, clean, and dry their boats. By having this message in multiple locations we are reinforcing the importance of it and constantly reminding boaters of proper procedures to prevent the spread of aquatic invasive species.

Overall, I learned a great deal from my experience working with the Lake Moraine Association this summer. Lake Moraine needs a sustainable stewardship program that can function from year to year in order to try to prevent the introduction of more Aquatic Invasive Species (AIS). In order for any Lake Association to utilize and most effectively leverage its volunteers, it needs to have a reliable group willing to donate their time week after week. However, there are many challenges with a volunteer organization. One suggestion is to identify a steward preferably in a paid capacity that will cover the boat launch during the peak hours to ensure coverage.
Project Summary:

The Sabrina Coast of the East Antarctic margin is a remote area that presents challenges for scientific data collection due to its limited accessibility. First-ever sediment cores from the Sabrina Coast shelf were taken during a 2014 Antarctic expedition aboard the RVIB Nathaniel B. Palmer (NBP1402). To comprehensively understand present climate conditions and changes, scientists look to past climatic history for assistance with modern day interpretation. Micropaleontology is a field within paleoclimatology that studies microscopic fossils. Diatoms, the microfossils examined in this project, are a type of marine algae commonly preserved in polar marine sediments. They serve as proxies for reconstructing climate and oceanographic change. In addition, diatoms frequently are used for biostratigraphic interpretation.

This summer research focused on a jumbo piston core, JPC 31, which was recovered during NBP1402. The retrieval location of the sediment core was based on multichannel seismic data; the site was selected to provide information on the timing of ice development in East Antarctica. The biostratigraphic work from NBP1402 focused on the absolute age of the strata through the correlation of the late Miocene diatom assemblage found within the strata.

My summer research project involved compiling microscope photographs of JPC 31 diatoms into photographic plates, used to illustrate the key diatom taxa present in this assemblage. The quantitative slides produced in the lab were photographed under 1000x magnification with oil immersion. A total of 6 microscope slides were scanned at 400x magnification to fully capture the complete diatom assemblage. This project worked with diatom biostratigraphic experts at Florida State University and University of Southampton. Biostratigraphic work led to an improved placement of the diatomaceous sediments within both a conservative and constricted geologic age range. The diatom assemblage suggests a major step in the development of East Antarctic ice sheets during the late Miocene, between 8.6-4.9 million years ago.
Project Summary:

This research applies the theoretical framework of transnational migration theory to conceptualize Congolese refugees’ sense of belonging, participation and inclusion in Durban, South Africa. This is especially significant as the data for the study was collected following Durban’s second large-scale wave of xenophobic attacks on foreigners, occurring in March of this year. The term refugee in this study is used to include individuals identified by the 1951 UNHCR Refugee Convention as, ‘someone who is unable or unwilling to return to their country of origin owing to a well-founded fear of being persecuted for reasons of race, religion, nationality, membership of a particular group, or political opinion,’ as well as those individuals seeking asylum awaiting refugee status. I argue that although demographically South Africa is a melting pot country, and despite forming livelihoods and networks, the ability for refugees to integrate is seemingly unachievable. This is made visible by acts of xenophobia perpetuated by structurally oppressed black South Africans who fear sharing limited resources with refugees in social, political and economic spaces.

Data for the study was compiled through ten in-depth interviews with Congolese refugees, along with participant and non-participant observations conducted while interning at the KwaZulu-Natal Refugee Council. The largest themes presented surround issues of a challenging of the South African concept of ‘The Rainbow Nation’, economic instability and structural exclusion as the root causes of xenophobia, notions of belonging and citizenship, interpretations of social cohesion vs. government action toward integration, and a reimagining of ‘home.’ The purpose of this research is not to vilify any specific group as perpetrators of anti-foreigner sentiments, but it is significant in that it underscores the effects of limited remedying of structural inequality and social cohesion initiatives by the State on refugees senses of belonging and identity. Furthermore, in a geopolitical context, this study draws attention to the transnationality of the refugee experience. Limited social cohesion and integration efforts in South Africa has led individuals to feel unwelcomed—they neither belong here nor there, dislocated from home but living on the fringes of social, political and economic life in the host country.


Title of Project:  Field School Fellow with the National Abolition Hall of Fame and Museum

Project Summary:

This summer, I had the opportunity to work at The National Abolition Hall of Fame in Peterboro, New York. The National Abolition Hall of Fame and Museum honors antislavery abolitionists, their work to end slavery, and the legacy of that struggle, and strives to complete the second and ongoing abolition – the moral conviction to end racism. I have always had a passion for studying history, especially American history of the Antebellum South, Civil War, Reconstruction, and the Civil Rights Movements of the late 50’s, 60’s and beyond.

I have grown up in communities where the demographics are different from those of the environment that I am currently surrounded by at Colgate. In the process of transitioning to life at Colgate, at times I felt that I lost the sense of comfort that I used to have at home when speaking so freely. I found myself speaking passionately on issues but sometimes felt as if I did not have the facts and information to back up what I was saying, as much of what I would say was based on personal lived experience. I felt that working at NAHOF may introduce me to the many voices behind a narrative that I hadn’t yet heard, giving me the tools to be able to articulate and share my ideas. I still want to learn more about and understand how the Black Lives Matter movement, the weight of the Confederate flag, ongoing police brutality and the continual murder of innocent people could relate to the work done by Abolitionists hundreds of years ago.

Working at NAHOF has given me the push I needed to pursue my goals of someday being a writer and an educator, and allowed me to solidify my goal of talking with others and ensuring that these stories do not go untold. This summer, I gave tours to diverse groups of people, from school aged children to groups of adults, and learned from their experiences. It was incredible to see how journalists, magazine editors, school teachers, politicians and professors all came together to hear the stories of Abolitionists. My first semester at Colgate, I took a history class called The African American Struggle for Freedom and Democracy. During the entire semester, I never realized that The Gerrit Smith Estate and other places that played important roles were just a few miles away. NAHOF has many books, art pieces and resources, including a preliminary draft of Lincoln’s Emancipation Proclamation, complete with his own smudged fingerprints. Great minds and orators like Frederick Douglass and abolitionist-women’s rights advocate, Sojourner Truth found guidance and support in Peterboro. Studying in the same space that they once found solace in was overwhelmingly powerful. One of the best things about working at NAHOF this summer was having the opportunity to meet with my boss, Dot Willsey, on a daily basis. She is one of my mentors, and helped me shape the way I understood and critically viewed the work and dedication of the Abolitionists. We came to the conclusion that we cannot separate ourselves from the past and our intertwined histories. Their work is far from being over.

☑ Other (specify):  Upstate Institute
Project Summary:

Kriemhild Dairy Farms of Hamilton, NY operates as a grass-fed dairy farm. Their main product that they sell to the public is their Meadow Butter, and Crème Fraiche, a sour cream styled slightly more towards Europe’s sour cream. I have been working with Lindsey Jakubowski, the General Manager of Kriemhild, to help bring the Dairy Grazing Apprenticeship (DGA) to New York State. This United States Department of Labor recognized apprenticeship program has recently decided to go national and move beyond its home state of Wisconsin. The main tasks that I have been charged with this summer have included reaching out to local farmers to test interest in the program, contact local agricultural organizations for support and networking purposes, and researching funding opportunities.

The nature of my project this summer is different from typical Upstate Institute projects, because I am working mostly to develop a not-for-profit organization, not to specifically work for one. One of my main difficulties in my project has been reaching out to people with a sense of legitimacy. Lindsey and I have both worried about having the Kriemhild name attached to either of us while we make our contacts, but we have also not been able to come up with an alternative. We believe some farmers would be apprehensive about seeing a different farm’s name attached to something that is supposed to be not-for-profit. We are not working to collect more milk for the Creamery to increase our own production, but that has been a question that has arisen quite often while making contacts. Also, we have tried to not have Colgate listed too closely to my name, because, as one of the women I met with from an agricultural organization said, “Why is a Colgate student working on this and not a Cornell one?” Though Colgate is located in a rural area, the students are far from rural in most cases.

My work is difficult to quantify because so much has been networking of sorts. We have been in contact with Joe Tomandl III, Director of the DGA, since my first week of work. He, along with his team of program coordinators, have been exceptionally helpful in answering our questions as to how the apprenticeship program works and how best to begin organizing the NYS chapter. Another great aid has been the feedback of one farming married couple in particular. They have hosted apprentices in the past and were able to ask very targeted questions that made Lindsey and I both think more practically about how we could solve future problems between Apprentices and Master Graziers.

I believe the bulk of the data concerning this project will come after several rounds of this apprenticeship are completed. Research has shown that increasing the amount of small (under 100 cows) dairy farms benefits the immediate community, while increasing the larger operations negatively affects income per household. Environmental impacts have shown a little bit of conflicting data, and I am not sure that anyone would be researching those effects, but it does seem that changing from confinement to grazing at a larger scale would positively influence our environmental health.

I think one of the biggest parts of this project is to go forward and see the grass-fed movement spread. At a small scale, there are some benefits, but at a large scale, we can change the negative perceptions of modern farming. The number of ripples that extend out from changing to grass-fed are numerous but will need time to show themselves.

Research Fellow: Lillian “Lillie” Pentecost (2016)  Concentration(s): Physics; Computer Science

Faculty Mentor: John Stratton  Department: Computer Science

Title of Project: Accelerating Dynamically Typed Languages with a Virtual Function Cache

Project Summary:

Dynamically typed languages, such as python and JavaScript, are increasingly important to programmers at all skill levels. They do not require unchanging types (static types) and provide the ability to maintain complicated class structures and multiple inheritance. However, dynamically typed languages incur some performance issues. For example, a key component of implementing these useful features is the use of virtual functions, but virtual functions are more costly than their static equivalents. Thus, we designed and implemented hardware support for virtual functions in order to improve overall performance of dynamically typed languages.

Virtual functions are different because their definition may be overloaded by derived classes or not defined within the object definition. Thus, the pointer to a virtual function must be retrieved via an indirect call, rather than using a direct call to execute the function. As shown in Figure 1, a full Virtual Function Call (VFCall) requires two additional load operations when compared to a direct call. The first of these loads is to retrieve the pointer to the virtual function table (vtable), which stores the pointers to all the virtual functions defined for that object. The second load is to retrieve the correct function pointer so that the virtual function can be executed. In order to improve performance of virtual functions, we designed additional hardware support that will eliminate one of these two load operations using what we have titled a Virtual Function Cache.

Following the retrieval of the vtable, the Virtual Function Cache will store the corresponding function pointers. If the function pointers can be directly retrieved from the Virtual Function Cache after the vtable is known, rather than requiring an additional lookup in memory, this could effectively eliminate one of the extra load operations required by a VFCall. Thus, this additional piece of hardware can potentially at least halve the overhead incurred by virtual function calls as opposed to direct calls. To examine this modification in more detail, Figure 2 shows the decomposition of a direct call vs. an indirect call both before and after our proposed modifications into MicroOperations. The VFCall Operation will incorporate the existing store operation to store the stack pointer in addition to executing the lookup in the Virtual Function Cache. In order to understand why this could be an effective solution, Figure 3 shows how the Virtual Function Cache is incorporated into hardware. In order to forward the results of the Virtual Function Cache lookup to validate branch (in place of the result of the eliminated load operation), a Call Queue is added and incorporated as shown in Figure 3.

Our preliminary results for an idealized example of virtual function use confirm that the overhead introduced by using a virtual function as opposed to a direct call is over halved, as expected. More specifically, the test using unmodified indirect calls is 47% slower than an identical test using direct calls, while the test using modified indirect calls is 19% slower than the test using direct calls. For a more direct comparison, the speedup from unmodified indirect call test to modified indirect call test is 24%.

Research Fellow: Kristine “Kris” Pfister (2017)  
Concentration: Art and Art History

Faculty Mentor: Julie Dudrick  
Department: Upstate Institute

Title of Project: Field School Fellow with The Sam and Adele Golden Foundation for the Arts/ The Horned Dorset Colony

Project Summary:

This summer, I worked as a Field School Fellow with two artist residency programs. Artist residencies give a time and place for artists to focus on developing their artwork, researching new ideas, or establishing collaborative explorations. Because artist residencies encompass a broad range of financial support, location, duration, and many other factors, there is no set model for this kind of organization. I was fortunate enough to work with two local residency programs: The Sam and Adele Golden Foundation for the Arts in New Berlin, NY and The Horned Dorset Colony in Leonardsville, NY. This dual experience allowed me to explore two different organizations of the same type and contribute a multitude of my skills within a single summer. Through my internships, I have gained great insight into the business side of the art world from two separate perspectives, a truly valuable experience.

My supervisors at the Golden Foundation, Barbara and Emma Golden, are ambitious people and take on many projects. As such, most of what I assisted with over the summer was the completion of daily tasks to increase long-term success. For example, I was able to create a spreadsheet of all artwork donated to the Foundation. This crucial information was not previously consolidated and by doing so, Golden can now find and use that information more effectively. My daily schedule was full of variability because the first priority of work was to ensure support for the resident artists. As such, I attended “technicals” - workshops designed to demonstrate the vast range of Golden Artist Color products available to the residents- checked in regularly with the artists, assisted with set-up for Open Studios and other events, and was the event photographer for many activities.

In preparation for the two groups of summer residents at The Horned Dorset Colony, I began with organizing and alphabetizing HDC’s library. I had also taken initiative on their digital platforms, emailing upcoming residents with relevant information about their stay as well as interviewing and photographing the current residents to create posts on Facebook. Near the end of my internship, I began researching grant opportunities for HDC; this included creating a detailed list of sources and developing templates and suggestions for the application process. Through this research, I identified that HDC could portray itself stronger in the area of community service, a crucial element to their grant eligibility. I investigated multiple opportunities for a community service program before developing and submitting a proposal to my supervisors.

My Fellowship at the Sam and Adele Golden Foundation for the Arts and The Horned Dorset Colony has been a fantastic experiential opportunity for me. Both Golden and the Horned Dorset Colony have been exceptionally welcoming, and I feel I have been able to make an impact with my time at each organization. Having the ability to work alongside such successful, kind, and ambitious people is not only a wonderful chance to network for my future in the Arts, but also to learn a great deal about art from a business standpoint and interaction in a professional setting. This dual experience has allowed me to grow my interpersonal skills, technical abilities, and professional understanding while contributing to a pair of incredibly successful organizations.

Source of Support:  [ ] AHUM Div.  [ ] NASC Div.  [ ] SOSC Div.  [ ] UNST Div.  [x] Other (specify): Upstate Institute
Muslims comprise an influential and increasingly large minority in the city of Utica, New York, as at least one in ten Uticans practice Islam. Thus, it is increasingly important to study the barriers and opportunities for the cultural and religious acceptance of Muslims in Utica. The challenges of Muslim resettlement in Utica as well as the triumphs of Muslims in revitalizing and reshaping the inner city of Utica and its identity are explored in this paper through relevant literature and personal interviews. This study seeks to show that although Muslims’ contributions to Utica’s economy continue to revitalize and redefine the city and lead to broader ethnic and religious tolerance, incidences of discrimination against Muslims still continue in Utica because of national and local media incitement, and suppress cultural exchange and integration between the immigrant communities and the city and among themselves. Also, Muslim cultural integration and exchange still lags behind economic integration due to lingering prejudice against Muslim communities and “Muslim-looking” people, and consequent self-segregation. The Muslim diaspora in the West is largely defined by socioeconomic marginalization due to Islamophobic prejudice.

However, overall, the Muslim communities that constitute Utica’s ethnic and religious pluralism generally experience a level of tolerance that should serve as a model for other cities in the United States and around the world. Utica’s enduring support for the Mohawk Valley Resource Center for Refugees and the continued immigration of people from the Muslim world is often echoed in the voices of city officials, as well as in newspaper articles, and in opinion polling of the general population of Utica.

This culture of tolerance is also evident in the number of mosques and Islamic associations in the city: the Kossuth Avenue mosque, Burmese mosque, and Somali Bantu Community Association, among others. The proximity of these associations to the city center, most notably the Bosnian mosque on Court Street, is a symbol of such acceptance and integration into the social fabric of Utica. Muslim immigrants’ inclusion into the economic fabric of the city is also a testament to their acculturation: the Muslim communities of Utica have created locally-famed businesses such as Ruznic Market, Karate Club Dragon, and Golden Burma Halal Meat Market, and have provided Utica with much-needed economic stimulus and an expanded tax base.

Utica, overall, is and has been a welcoming community for immigrant and refugee populations, where diverse communities coexist and serve as a model for tolerance. However, as the region’s cultural and religious diversity continues to increase, the further inclusion of Muslim immigrants and refugees into the economic and cultural fabric of Utica is required for the city’s evolution and growth in standard of living and commitment to protecting human rights and religious freedom. Encouraging integration of immigrant communities’ businesses and religio-cultural sites in the city center, such as the establishment of the Bosnian mosque on Court Street, will increase the visibility of Utica’s pluralistic identities, stimulate dialogue between different populations in Utican civil society, better integrate ethnic enclaves, and, hopefully, lead to greater understanding and tolerance between all refugee, immigrant, and native Utican ethnic and religious groups.
Title of Project: Toward the Preparation of a Conformationally-Viable and Robust Tn Antigen: Synthesis of the Amino Acid Alkene for Cross-Metathesis

Project Summary:

Glycoproteins are proteins often found on the surface of cells that are adorned with carbohydrate chains known as glycans. These glycoproteins play an important role in cell-to-cell functions, such as cell recognition and signaling. A specific O-linked glycan, known as Tn Antigen, is only present in cancer cells, and serves as an important marker for the disease. Our goal is to create a conformationally viable and stable Tn Antigen mimic (Figure 1) that can be used for cancer vaccination research. Naturally occurring Tn antigen is considered unstable, as it contains an acetal group, which is susceptible to acid and base cleavage, as well as enzymatic hydrolysis. With the replacement of the O-linkage with a C-linkage, our mimic is no longer susceptible to acidic hydrolysis, and the addition of a hydroxyl group incorporates intramolecular hydrogen bonding, which has previously been found to be important to the conformation of the molecule.

My goal this summer was to prepare the amino acid portion of the mimic for an eventual cross-metathesis. The reaction pathway, seen in Figure 2, began with a D-serine derivative, followed by protection of the nitrogen and oxygen, reduction of the ester to an aldehyde, a vinyl Grignard addition (a necessary part of the molecule for the cross-metathesis), and lastly an acetylation to complete the amino acid portion for the cross-metathesis.

The second portion of the summer was spent trying to determine the ideal reaction conditions to perform the cross-metathesis. Using a carbohydrate alkene, a variety of the cross-metatheses were attempted under various reaction conditions (temperature, ratio of reactants, varying solvents, solvent concentrations, and different ruthenium catalysts). While the cross-metathesis was confirmed by MALDI mass spectrometry, the product was unable to be isolated from the carbohydrate self-metathesis product. Further test reactions will be attempted in the future, to find the best conditions to perform the cross-metathesis between the amino acid and carbohydrate portions of our Tn Antigen mimic.

Research Fellow(s): Ann “Annie” Preston (2016)  Concentration(s): Geology, ENST
Rebecca Siladi (2016)  Concentration: Geology
Teymoor Tahbaz (2016)  Concentration: Geology

Faculty Mentor: Bruce Selleck  Department: Geology

Title of Project: Stratigraphy & Sedimentology of the Ordovician Sequence in the Wells Outlier, Adirondack Park, NY

Project Summary:

This project involves field and laboratory study of Late Ordovician (457 to 450 million years ago) Black River Group and Trenton Group sedimentary rocks in the central Adirondacks. The site is in the town of Wells, New York, located in a graben (normal fault-bounded) valley. The Wells outlier is surrounded by the much older Grenville igneous and metamorphic basement rocks that are approximately 1.1 billion years old. Our research, using logged drill cores and quarry face exposures, has already demonstrated the presence of a reverse fault at the Greymont Quarry site. This fault brings older units up over the younger Utica Formation as seen in the schematic cross section.

In addition, we are correlating the sequence at Wells with other Late Ordovician exposures in the northern Appalachian Basin. The logged core and outcrop can be linked to the other exposures using K-bentonite layers. K-bentonite is a clay-rich ash deposit from a volcanic event. The geochemistry of minerals such as zircon and apatite can be used to link the ash unit between different sites. (The ash layer is indicated by the red line in the stratigraphic columns) Our preliminary observations show that ash layers at the Greymont site are present in other Late Ordovician exposures in New York State.

We are using hand sample and thin section petrology and mineralogy, and clay mineral analysis, to determine the depositional setting of the sedimentary rocks that form the Late Ordovician succession at the Greyemont site. The sedimentary environments at the time of deposition, and the possible occurrence of faulting during deposition (synsedimentary faulting) are to be determined. The presence of coarse, angular quartz sand grains in the Black River Group, and pebble to cobble-size clasts of basement rocks in the lower Trenton interval suggest that active faulting uplifted nearby sediment sources during deposition of these units in the Wells graben.


Figure 1: Stratigraphic column of the measured outcrop and two core sections in Wells Quarry.

Figure 2: Cross section of the suspected reverse fault at Wells Quarry.
Project Summary:

Until very recently, development policy in the global south has focused exclusively on state-centered approaches. Traditional beliefs that states and state-established subsidiaries are the only governing entities with the right to make and enforce laws have constrained grassroots forms of economic and political development. In particular, Peru’s neighborhood organizations, which govern the country’s informal housing settlements (commonly known as ‘slums’ or ‘shantytowns’) are severely impacted. Though Peru’s neighborhood organizations take on the roles we typically associate with government, including service provision, security, legal rulings, etc. they are traditionally viewed as civil societies without the right to make and enforce laws because they are created informally without the aid of the state. Without the legal right to make laws at the local level, we restrict the development of informal housing settlements to top-down approaches that place the human rights of informal settlers in the hands of local elites, who are often unprepared or unwilling to aid in the development of informal housing settlements, leaving millions without basic human rights.

In this paper, I utilize philosopher Allen Buchanan’s theory of political legitimacy to argue that Peru’s neighborhood organizations should be considered politically legitimate governing entities with the right to create and enforce laws. I begin this task by developing criteria for the political legitimacy of neighborhood organizations based on Buchanan’s Natural Duty of Justice. From here, an extensive literature review, supported by interviews with neighborhood leaders in Lima and Arequipa, Peru is carried out to determine if neighborhood organizations can meet our standards for political legitimacy. By fulfilling this task, I defend a moral imperative to recognize the legality of neighborhood organizations, granting them a right to limited self-governance. This will strengthen the ability of neighborhood organizations to provide for the human rights of informal settlers, while also supporting a new foundation for development policy that is focused at the grassroots level. When applied globally, this work should have significant impact on the lives of world’s urban poor by giving them a central role in urban development.
Research Fellow: John Quazza (2016)  
Concentration: Geology

Faculty Mentor: Karen Harpp  
Department(s): Geology; Peace and Conflict Studies

Title of Project: Investigation into the Insulating Properties of Tephra on Basaltic Lava

Project Summary:

This summer I had the opportunity to do what most people never see in their lifetime. I was able to work with lava, the molten rock that comes from volcanoes. I did not, however, have to travel to the west or to the south; in fact stayed up in Hamilton, New York and for a week went to Syracuse University for my research. At the Colgate facilities, I made my own lava from a basaltic rock, the type of material erupted from rift zones and ocean island volcanoes. While cooking rocks may seem fun, it is not like what happens on the average cooking channel. For optimal melt, the rock had to stay at 1200°C for multiple hours in a muffle furnace. After becoming completely molten, the lava was removed from the furnace using proper safety gear, and placed on a table. I then used thermocouples, or simply big thermometers that record temperature data with time, to keep track of the cooling rate of the lava until it was no longer dangerous to handle. I then repeated this experiment, adding various thicknesses of tephra (small pieces of fragmented lava that are very porous and erupted from every basaltic volcano during the peak of its activity), recording the cooling rates of the underlying lava.

The objective of these experiments was to determine the insulating effect of tephra deposits on lava. This information also helps me understand more about the formation of clastogenic flows and how they pose a hazard at basaltic volcanoes. Clastogenic flows result from the accumulation of tephra on the flanks of volcanoes. If the deposition rate is high enough, the tephra remains molten, and the accumulated tephra can remobilize and begin to flow down the flanks. This phenomenon is also known as a rootless flow due to its ability to be initiated at a distance from the vent. This particular lava flow hazard is often overlooked in hazards mitigation studies, yet is a common occurrence and poses a significant threat to many communities built on the flanks of basaltic volcanoes in places such as Hawaii, the Azores, the Galapagos, Iceland, Italy, and many more.

I then scaled up my experiments significantly, to be appropriate for the facilities at the Syracuse Lava Project (fig. 1). At Syracuse, there is a system that permits generation of lava flows that are made from several hundred pounds of basalt, the largest man-made lava flows in the world. Here, I carried out two sets of experiments. The static experiments consisted of lava poured into a container, which was then covered in different amounts of tephra. These were large versions of the experiments performed at Colgate. In each static bucket, we placed one or two thermocouples. These thermocouples were attached to data loggers, which would record temperature over pre-determined time intervals. The tephra was deposited on top of the lava, which was then allowed to cool. We also performed dynamic flow experiments. Here, lava was poured down a ramp from its source. We then placed variable thicknesses of tephra on top of the lava to determine its effect on flow length, thickness, and cooling rates. We recorded these data using thermocouples with data loggers (for the internal lava temperatures) and infrared pictures (fig. 2) for surficial temperatures. With the help of Professor Robert Wysocki of Syracuse University and Dr. Karen Harpp of Colgate University, we were able to produce multiple lava flows and study their thermal properties and the insulating effects of tephra. I anticipate that my ongoing studies will advance our understanding of rootless, clastogenic flows and the hazards they pose to surrounding communities.

This fall semester I will be continuing my interpretation of this data we collected from all of our experiments. My goal is to be able to determine when a clastogenic flow may become more of a hazard than initially expected based upon the amount of tephra deposited on its surface and the amount of time the flow will be projected to stay at a dangerously hot (and therefore mobile) temperature.

Source of Support:  
☐ AHUM Div.  ☐ NASC Div.  ☐ SOSC Div.  ☐ UNST Div.  
☒ Other (specify): Doug Rankin ’53 Endowment-Geology Research
Project Summary:

I spent this summer on two projects while working at Colgate University. The first, on which I spent most of my time, was separating detrital zircon crystals from metamorphosed sandstones found in the Mesoproterozoic Grenville Province of the Adirondacks (NY), Quebec, and the New Jersey Highlands. These samples will be used for U-Pb dating to determine sedimentary provenance. The other project was separating titanite crystals from Grenville marbles in Quebec. Titanite is a metamorphic mineral, and captures the time of cooling from high metamorphic temperature.

Zircon Separation: In order to separate the detrital zircon crystals from quartzite there were a few steps that needed to be taken. The first was picking the samples that had the most zirconium. To do this I used a hand-held X-ray spectrometer to see the percentage of the sample that was Zirconium. Samples with the highest percentages were crushed into a fine sand using a shatterbox. After crushing, the sample was sieved to make sure the grains were roughly the same size. When the entire sample was crushed, it was put through a mechanical water wheel in order to separate the denser zircon crystals from the less dense quartz crystals that were in the rock. After the sample was processed, I would re-run the lighter part of the sample again to retrieve any heavy minerals that had been missed. When both of these heavier samples were dried, they were sieved through 185-micron mesh in order to separate the larger grains, because typically the zircon grains were significantly smaller. After this was all sieved, the ≥ 185-microns split was put through a Franz magnetic separator. This would separate the zircon and quartz that was still left from garnet and other slightly magnetic minerals at the specific amperage (0.50 amps). Once this was complete, the samples containing the most zircon were put through methylene iodide to float (and remove) remaining quartz. At this point, the zircon was effectively separated out from the rest of the rock.

Titanite Separation: In order to separate out individual titanite grains from the marbles collected around Quebec, some of the sample was crushed by hand using a mortar and pestle. I would then sieve the sample in order to remove some of the larger grains. The sample was then processed through the Frantz used to magnetically separate the zircon crystals, in order to concentrate the titanite into a smaller sample. The sample was processed a few times, at 0.50, 0.85, and 1.65 amps. Generally the sample with the highest amount of titanite was the non-magnetic sample after 1.65 amps, but occasionally the non-magnetic after 0.85 amps yielded the most titanite. I would then hand-pick the titanite using tweezers and a binocular microscope.

Scanning Electron Microscopy: One part of my summer research was learning how to operate the scanning electron microscope (SEM). Once I was able to use the SEM, I used it to identify some minerals for geochronology using X-ray spectrometry, like titanite. I also used the cathodoluminescence (CL) detector to examine zoning and take some pictures of previously dated zircon crystals from Adirondack Quartzites, and measured aspect ratios of the crystals. I then compared the crystals measurements and visible CL with their U-Pb ages to see if there was any correlation. None was observed.

Research Fellow: Catherine Quirion (2017)  
Concentration: Neuroscience

Faculty Mentor: Julie Dudrick  
Department: Upstate Institute

Title of Project: Field School Fellow with Pathfinder Village

Project Summary:

Pathfinder Village is a world-renowned community for individuals with Down Syndrome. Their programs allow for support for people of all ages, from a high school for students ages 7 to 20, to a residential program. I worked closely with staff developing the village’s newest program, Otsego Academy. Otsego Academy (OA) is a post-secondary education program that began this past year for individuals with intellectual disabilities especially but not limited to Down Syndrome. I created a report about the first year of the Academy and looked at assessments that were done at the student’s first arrival in the village as well as during their last week of class. I also wrote about different highlights that happened during the year and different opportunities the students had in order to show the students’ overall experience in this first year. This report was also used to look at what could be done better in the assessment period as well as what was done very well.

Post-secondary education in the field of disabilities is severely lacking in knowledge, funds and support. Very often, individuals with intellectual disabilities (ID) have very few options after they leave high school. It is often much harder for them to find and keep jobs and they really often need constant supervision and acquiring independence is very difficult. Because of this, very often individuals with ID become unemployed and rely heavily on family members to help care for them. Post-secondary education for individuals with ID is different from the mainstream college experience and geared towards attaining different goals, the first being independence. Otsego Academy is one of these emerging programs that provide students with ID a chance to attain independence through their three part program. Otsego Academy has a residential program, a vocational program, as well as an academic program. The students live in a house with other students and are asked to do everyday chores such as laundry, cleaning, and even cooking. While at school, students learn specific subjects connected to independence such as money management, resume building, interview skills, personal management, etc. In two years at OA, students are also introduced to many different employment opportunities through job exploration days, as well as short and long internships. The combination of these three aspects of life makes for well-rounded people and provides skills that are crucial in obtaining independence and living a normative lifestyle.

Source of Support:  
☐ AHUM Div.  ☐ NASC Div.  ☐ SOSC Div.  ☐ UNST Div.  
☒ Other (specify): Upstate Institute
Title of Project: Effects of Liming on Acidic Adirondack Soils

Project Summary:

Studies of the impacts of acid precipitation on the Adirondack Park in upstate New York began in the mid 1970s when Adirondack lakes and forests were seen to be suffering from the effects of acidification. In 2005, limestone powder was applied to the surface of forest soils at four different sites on a tract of state land in the Town of Webb to see if it would counteract the negative impacts of acid precipitation by neutralizing the acid and adding calcium, an important nutrient that was being leached from the soil by the acids. The purpose of this research, which will continue through the upcoming academic year, is to investigate the fate of the lime and its impact on the chemistry of the soil one decade after its application.

Each site established in 2005 consists of two 45 m diameter circular plots – one limed plot and one unlimed control plot. Soil samples for this study were collected from soil pits dug in both the unlimed and limed plots at Webb sites 5 and 10. Depending on horizon definition, samples were taken by horizon or in 5 cm intervals over the depth of the pit. Prior to analysis, all samples were first air-dried then sieved to remove the >2 mm material. Exchangeable cations were analyzed on 1N NH\textsubscript{4}Cl soil leachates using Atomic Absorption Spectrometry. Exchangeable acidity was determined by titration of a KCl soil leachate to a pH 8.3 endpoint. Soil pH was measured on a 1:1 soil/RO water suspension using a pH meter.

Results from this research give strong evidence that the applied limestone is neutralizing acids in the upper 15 cm of the soils (Figure 1). The average pH of the limed soils is ~1 pH unit higher than the unlimed soils at 15 cm depth, and increases to nearly 3 pH units higher (~1000 times lower acidity) at the surface. A decrease in soil acidity is also indicated by the exchangeable acidity values, for which the top 10 cm of the limed soils have levels at or below zero, whereas the upper 10 cm of the unlimed soils show some of the highest exchangeable acidity levels, approaching ~4.6 cmol/kg on average.

In addition, results from this study show that calcium from the lime has infiltrated the soil to a depth of approximately 30 cm (Figure 2). This is especially apparent in the upper 10 cm of the soil profile where exchangeable calcium values are ten-fold higher than in the unlimed plots.

Future work will attempt to pinpoint the depth to which the lime has influenced the soil, and will investigate whether the liming has impacted the chemistry of the understory plants in these plots.
Research Fellow: Rebecca Rist (2016)  
Concentration: Physics

Faculty Mentor: Rebecca Metzler  
Department: Physics and Astronomy

Title of Project: Composition and Structure of Oyster Cement Provides Unique Materials Properties

Project Summary:

My research project examined the structural and chemical composition of an oyster, the *Crassostrea virginica*. This oyster creates an adhesive in which it uses to cement to other oysters, allowing these oysters to aggregate into colonies. Once they cement to each other, they are cemented for life. This adhesive is extraordinary—it is flexible yet strong enough to function in tidal environments. By examining both the chemical and structural properties of this adhesive, my professor, Rebecca Metzler, and I hope to help identify how the *Crassostrea virginica* creates this adhesive. Through completion of this research, we will be closer to synthetically recreating this adhesive, so it can be used as a biomedical adhesive, or any adhesive utilized in a wet or unstable environment.

I specifically measured the hardness values of the oyster’s cement and shell with the goal of correlating hardness to particular elements and materials within the two components. I measured hardness values for geologic calcite and aragonite, of which the shell and cement are made up of, to serve as a comparison. The cement is significantly softer than the shell with the results shown in Figure 1. By jointly examining the elemental composition of both the cement and shell, results are shown in Figure 2; we found that the cement contains soft regions high in carbon and hard regions high in silicon.

![Figure 1](image1.png)  
![Figure 2](image2.png)

Source of Support:  
- [ ] AHUM Div.  
- [x] NASC Div.  
- [ ] SOSC Div.  
- [ ] UNST Div.  
- [x] Other (specify): Justus ’43 and Jayne Schlichting Student Research Fund
Title of Project: Using Python for Astronomical Research on Quasar Variability

Project Summary:

Python is a popular programming language that is free and easy to learn, and has the potential to be a very useful way to display, analyze, and interact with data. I began learning Python early in the summer with the goal of creating interactive graphs for analyzing our observations of the blazar 3C 454.3, the astronomical object my research group was mainly interested in. Blazars are a subset of quasars, which are very distant galaxies with very bright, active cores; however, the mechanisms driving quasars are not well understood.

During the summer, I became proficient in generating graphs with widgets and other customizable features. For example, the buttons in my code allow the user to select any combination of data sets to display, and the cursor, when hovering over a point of data, shows the exact magnitude (brightness) for 3C 454.3 at that time. The graph itself shows 3C 454.3’s light curve, using both Colgate data and Yale SMARTS data. It shows how 3C 454.3’s brightness, in several colors, has changed over the course of two decades. Such information is useful in determining the physical processes taking place within the blazar.

Aside from Python, I learned how to operate the 16” telescope at the Foggy Bottom Observatory to take images of several quasars. I also used IRAF scripts written by previous Colgate students to process and perform aperture photometry on our images. I also studied the physics of quasars, the current theories for the mechanisms behind quasars, and several historical studies of 3C 454.3.

![Figure 1](image_url)

**Figure:** The result my Python script: an interactive graph of 3C454.3’s light curve.

Research Fellow: Leda Rosenthal (2018)  
Concentration: Undeclared

Faculty Mentor: Julie Dudrick  
Department: Upstate Institute

Title of Project: Field School Fellow at Cornell Cooperative Extension

Project Summary:

The Cornell Cooperative Extension (CCE) in Madison County serves the county’s greater wellbeing by supporting local farmers to maintain, promote and expand their operations. CCE Madison County’s largest event of the year is Open Farm Day, which took place on July 25th. Open Farm Day is a promotional event where farms across the county encourage visitors to come and participate in various on-farm activities and experiences, including, but not limited to, farm tours, petting zoos, and demonstrations. As a fellow at CCE, I have had two major research projects in addition to our preparation for Open Farm Day.

My research projects were both based on alternative farming. The first was focused on alternative methods and yielded a typology of methods best suited for Madison County. My most significant contribution, and second project, was a literature review of agritourism—which is the tourism of farms, both hands on or educational—that included recommendations for Madison County and its potential engagement in agritourism.

Madison County farms have prime demographics for successful agritourism. To begin, only 26% of the county’s farmland utilized, which means that there is a significant amount of land could be made profitable (Figure 1). Secondly, almost all farm operators in Madison County are full-time owners meaning most have the agency and land to engage in agritourism (Figure 2).

My research has revealed that agritourism is most successful when marketed as a memorable experience. To retain visitors is a sign of success, however, monetary gains are also a clear indicator of whether or not a venture is successful. Most agritourism ventures do not require a large investment. For instance, pick-your-own operations only require a few purchases beyond the plants themselves.

There is no simple science to engaging in agritourism. All across the world different farms have begun to experiment. However, there are a few constants in successful agritourism. First, farmers who target a specific market typically are more successful. One must think to “whom” are they selling? Typically urban markets prefer more leisurely experiences whereas those from rural communities may prefer working on a farm or participating in more authentic experiences. Thus, one must consider what is best for their farm and location. One can also increase income from value-added products, like souvenirs without adding expenditure. Marketing the community as a whole is also proven successful. It is important to remember that if the community itself is not unified and enjoyable, it is unlikely the consumer will make return visits—which is the goal. Thus, it is important to support fellow community businesses to increase community’s gross income, too. Finally, success in agritourism is strongly correlated to a degree of academic achievement. Farmers must be innovative and continually change practices to stay competitive in the market and to continue to boost their own farm, and the community’s holistic value. All demographics have different expectations, but it essential to try to best fulfill these wants and need. The return of visitors to ones farm is the best sign of consumer retention, or thus, success. Agritourism cannot alone save the “American Farmer,” but an increase in local purchases and visitation to farms is a step in the right direction.

Title of Project: Single Mutation of H. influenzae Beta-Carbonic Anhydrase

Project Summary:

Carbonic Anhydrase is a zinc metalloenzyme, which means that in its active state it contains at least one metal ion important to its biological function. Carbonic Anhydrase catalyzes the reversible interconversion of CO2 and bicarbonate:

\[
\text{CO}_2 + \text{H}_2\text{O} \rightleftharpoons \text{H}^+ + \text{HCO}_3^-
\]

There are six evolutionarily distinct forms of carbonic anhydrase currently known. We are studying mainly the beta-Carbonic Anhydrase form which is found in bacteria and plant chloroplasts. We are mainly focused on the allosteric enzyme H. Influenzae Carbonic Anhydrase (HICA), which is regulated by the bicarbonate ion. The active state of the enzyme is stabilized when the bicarbonate ion binds to the site. A proline shift (give reference) allowed for the comparison of both the active and inactive conformations of the protein. These results stressed the significance of the N-terminus for the stabilization of the active, R-state of the enzyme. Furthermore, these results opened up the exploration of artificial disulfide bonds between two specific sites: L7C and T53C. This double mutant was created to test for the construction of a redox-regulated beta-carbonic anhydrase, potentially of the inactive T-state to the active R-state for example. Computer modeling suggested that the substitution of Cysteine at both Ala15' and Gly186 would allow for the formation of disulfide bonds between them. In other words, it seems plausible that an “artificial” disulfide bond will limit the mobility of the alpha 1’ helix, thus stabilizing the inactive, T-state of HICA in a redox-controllable way.” (Rowlett 10). This variant was successfully created, but did not appear to be significantly affected in function by the presence of the disulfide bond. The double mutant protein L7C and T53C was created to more critically test the idea of using an artificial disulfide linkage to control activity. Under reducing conditions, such as in the presence of DTT, the enzyme would be expected to have a larger kcat/Km than under oxidizing conditions (or vice versa). Stopped-flow spectrophotometry was used to measure the enzyme activity of L7C/T53C with DTT and results showed the double mutant was inactive in the presence or absence of reducing agent. An L7F mutation had already proved not to affect the enzyme's function, suggesting that the single mutation T53C must be significant enough to alter the structure and activity of the enzyme. To test this theory, HICA with the single mutation of T53C was created and tested on stopped flow spectrophotometry.

Beta-Carbonic Anhydrases are made up two classes, Type I and Type II, with Type II having allosteric regulation by the bicarbonate ion. Additionally, intermolecular contact plays a role in the structure of function of the Type II B-CA enzyme Haemophilus Influenzae carbonic anhydrase (HICA). Site-directed variants L7C and T53C were created to create an artificial disulfide bond in order to set up a redox control of HICA by linking the N-terminal helix of one protein chain to its neighbor. This N-terminal helix interaction is known to be important in regulation of HICA. These variants were overexpressed, purified, and then tested in stopped-flow spectrophotometry to assess the enzyme's activity. The Double mutant had less than 1% activity, so a T53C single variant was then created, overexpressed and purified by IEX, HIC, and GEC. The T53C variant was analyzed in kinetics and is currently being optimized to produce crystals. Stopped-flow spectrophotometry showed that the single mutant was very active, leading us to believe that the double mutant previously produced was a bad preparation. A new preparation of the L7C/T53C mutant was produced and then analyzed with stopped flow spectrophotometry. This time the results showed that the double mutant was indeed active and that it must have been a bad preparation for the previous.

The gas phase electron diffraction is a technique, in which a beam of fast electrons is scattered by the potential from charge distribution in a certain molecule. The interference pattern can be used to analyze the molecular geometry and relative positions of the atomic nuclei. In turn, the information on the molecular structure and the relative positions of atoms can be used to analyze the bond lengths, bond angles, torsional angles, and vibrational amplitudes. In this study, the molecular structure of Bis(1,1,5,5,5,-hexafluoro-2,4-pentadionato)Zinc was analyzed using the gas phase electron diffraction data of Zn(HFA)₂.

Theoretical calculations showed that the heavy atoms of the HFA group are planar. These two planes are perpendicular to one another with the zinc atom forming four Zn-O bonds. Theoretical calculations also showed that the lowest energy conformation for the CF₃ groups is eclipsing the C-C bonds. Preliminary least squares analyses of the electron diffraction data showed that additional features are needed in order to obtain satisfactory agreement.

Models with the following features were tested a) the fluorine atoms on the CF₃ groups were allowed to eclipse either the C-C bond or the C-O bond b) the perpendicular planes were allowed to deviate from 90° and c) the Zinc atom was allowed to move towards and away from the HFA group. The features were tested both independently and in conjunction with other features. No definitive conclusions can yet be made and data analysis is still on-going with hope to obtain the best model describing the gas phase structure of Zn(HFA)₂.

![Theoretical structure of Zn(HFA)₂](image)

**Figure 1: Theoretical structure of Zn(HFA)₂**

![Radial Distribution Curve of Models a, b, and c.](image)

**Figure 2: Radial Distribution Curve of Models a, b, and c.**

**Source of Support:**  
☐ AHUM Div. ☒ NASC Div.  
☐ SOSC Div.  
☐ UNST Div.  
☒ Other (specify): Science and Math Initiative-SMI (NASC Division)
Research Fellow: Zachary “Zac” Sawin (2016)  
Concentration: Geology

Faculty Mentor: Karen Harpp  
Department(s): Geology; Peace and Conflict Studies

Title of Project: Exploration of Hazards Mitigation Methods for Basaltic Lava Flow

Project Summary:

This summer I had the unique opportunity to work with people on the cutting edge of Geological—more specifically volcanological—research in order to expand our knowledge of how lava flows move. The reason for conducting such research is to better understand and therefore diminish the serious, ongoing threats that these lava flows pose to infrastructure including residential and commercial properties as well as human lives. The only way we know how to accomplish that goal at this time is to spray down advancing lava flows with water in hopes to slow it or stop it. This method has proven less than efficient both monetarily as well as time wise. Through collaboration with Syracuse University’s Lava Project spearheaded by Robert J Wysocki, an art professor turned lava enthusiast, we were able to break the mold of traditional lava flow research and approach hazards posed by basaltic flows in a more proactive way instead of reactive, as it has been done in the past. Previous investigations of basaltic flow hazards mitigation have been limited to case studies from the observation of natural flows, and the application of mathematical models to predict the dynamic properties of lava flows. With the lava generating apparatus (fig.1) at Syracuse, we were able to control for temperature, viscosity, material melted, as well as length and duration of flow.

The first 6 weeks of my 8-week stint were spent doing experiments in the bowels of the Ho Science Center to determine the best possible geometrical arrangement of barriers that would effectively divert lava flows using various lava analogues. First I used hot wax and ran it down a ramp covered in barriers of different shapes, placed at various angles designed to divert the flow from its original path. Once I found an arrangement that was effective I increased the scale significantly and repeated the experiments using PEG (polyethylene glycol), a common lava analog used by many researchers for similar applications because of its crust-forming ability. In the wax and PEG experiments, I documented flow thickness and pathways around the barriers to refine the design. For my work at Syracuse, I set up a system to use a 3-D modeling in order to make a digital elevation model (DEM) of lava the flows. This system records thickness of flow in a three dimensional theater. It consists of a 12-camera rig (fig.2) that we used to take simultaneous shots at every angle of the flow as it traveled through our various barrier configurations, 6 in total The days we spent gathering our data at the actual lava maker were quite possibly the hottest days in upstate New York history, with the outside temperature reaching around 95F, and the massive lava rig pictured below giving off heats of about 2000F it got pretty steamy to say the least. The machine was a thing of wonder, 15 feet tall and able to pump out hundreds of pounds of molten rock in about a minute and a half. The most breathtaking thing was the heat that the rock gave off even minutes after it solidified, we were required to wear special gold plated face shields along with leather and reflective metal garments in order to stave off being burned alive. Despite the layers of protective gear, I definitely came out with some burns, nothing serious, but enough to make me respect the power of this awesome machine and the natural process it attempts to recreate, pretty successfully I might add. Obviously exact science like this is not an exact science, so there were some confounding variables including the fact that the furnace was hotter than that of an actual lava flow and caused the molten rock to be a little more glassy than real life lava; however, no one else on the planet has ever come close to replicating a lava flow to the success that Bob and his team have. This research will also be the basis of my senior thesis. I would like to thank the Geology Department Alumni for making this summer possible, it was an experience I will never forget and am thankful to have been a part of. Special thanks to Dr. Karen Harpp, Bob Wysocki, John Quazza, Enika Rader, Maggie McGuire, and Kevin Varga for sweating it out with me, I would not have been able to make this happen without them.

Project Summary:

I worked with Sculpture Space in Utica, which is located in the center of Utica, New York. Sculpture Space is a resource for sculptors from around the world that provides an opportunity for creative exploration, community collaboration and public engagement. The organization promotes interaction between visiting artists and the local community, and gives the public an opportunity to meet innovative artists and learn about contemporary sculpture. Sculpture Space places works in the public domain, hosts studio tours, welcomes school groups to meet and watch working artists, collaborates with other organizations to exhibit artists’ projects, and arranges lectures at surrounding educational institutions.

Sculpture Space is a complex and creative place to work. While there, I worked on a variety of projects for Sculpture Space, including an archiving project, and an exploration of increased use of social media. I kept a blog about the experience of working in such a creative space, to document and assess the creation of a community garden at Sculpture Space, and to also explore the use of new technology in the garden. This technology includes the use of Public Participatory GIS (PPGIS) with students from the Thea Bowman House, and Photovoice, which has participants use photography to explore themes of social action. In this case, Photovoice will engage community members as they reflect on their community's environment, needs and assets in order to promote dialogue about a community and spur change. Photovoice attaches a dialogue or a narrative to a picture, and becomes an effective way of inspiring change in a society with a united goal of revitalization, improvement and safety. I thought it would be especially useful and relevant for a multicultural city like Utica because images transcend cultural and language barriers.

Sculpture Space has altered my perspective on what it means to “work.” What drew me to a community-based partnership such as Sculpture Space was the fact that they are motivated by care for the community and artistic/intrinsic passion, rather than by profit-making. The artists and staff here aren’t motivated by anything other than their own passions and artistic goals. People here work from within, drawing on their own inspirations and on each others’.

Title of Project: Five Centuries of Orientalism on China: An Anthology with a Critical Overview

Project Summary:

The project started with the question “what do western philosophers think of China?” Professor Wang noticed that many philosophers from the nineteenth century and twentieth century held the view that “China was stagnant”. To understand and interpret this phrase, Professor Wang traced back to the enlightenment era, where modern western philosophy was born. Therefore the question got more specific as “What did western philosophers from the enlightenment era think of China?” To answer this question, Professor Wang and I looked up works of philosophers from the enlightenment era and analyzed the context that refers to China.

As for my research, I usually read books assigned by Professor Wang or do research on western philosophers (mostly from the 17th century, 18th century and 19th century) in the morning. For afternoon, I help compiling Professor Wang’s notes into electronic form and put book information, page number and chapter title within the file so it would be convenient for Professor Wang to review her notes afterwards. Often, Professor Wang and I met around 16:30 to conclude and discuss any worth-noticing findings of the day.

The research on books published on China in the recent decades was one big part of my work. At first I tried to search keyword “China” or “Chinese” in Worldcat to see how many results come out. The result turned out to be too many so I had to narrow my searching range. I followed Professor Wang’s advice and looked through certain publishers such as Routledge, SUNY Press, etc. Then I would read the summaries of the books I found and put those I consider representative in the list I made. This process enhanced my ability of grasping the main ideas of books in a limited time and helped me better understand how western scholars think of China in the recent decades.

Also, I did research on several philosophers to find out what and from where did they talk about China. I would put the sources and information I found in a word file in computer so it would be easy for Professor Wang to see my findings. Some examples of the philosophers I did research on are: Max Weber, Jean-Jacques Rousseau, David Hume, Arthur Schopenhauer, John Dewey, etc. The progress of my research was not always smooth since it was sometimes difficult to find the resources I want through internet. I used sites such as Google scholar, worldcat, ConnetNY, and Amazon books. I also searched through Chinese searching engine to see if there was any finding I did not notice in the English websites. Such process enhanced my research skills and deepened my understanding of modern western philosophy system.

I really appreciated Professor Wang and Colgate to offer me the opportunity to do this summer research. Not only did I have honor to help and know Professor Wang better, but also I had the chance to enhance my academic research skills which I believe would be very helpful in my future life and studies.

□ Other (specify):
The Adirondack Mountains are a “circular” dome of forested mountains northeast New York State. Until relatively recently, the Adirondack region experienced high levels of human-induced acid rain. My research this summer aimed to determine whether mineralogical changes in soil had occurred from a mitigation tactic that had been used to counteract acid rain in the Adirondack: liming. Liming, in essence, is the addition of calcium carbonate to soil in order to neutralize acidity and replenish calcium, an important nutrient for plants and animals. Specifically, I was interested in the question: does liming alter the nature of clay minerals in any way? Clay minerals are an important component in the nutrient cycle of soils because of their tremendous surface area and their ability to retain and release base cations used for plant growth.

In the summers of 2005 and 2006, four forested plots in the Adirondack Park were limed with calcium carbonate. Each limed site had an adjacent control plot that remained un-limed. For the purpose of this study, two sites were re-visited and soil samples were taken from these sites. To determine the clay minerals present in the soil, I ran a series of X-ray diffraction (XRD) analyses on respective chemically-treated clay slides. Clays were air-dried, subjected to ethylene glycol solvation, saturated with potassium and exposed to varying degrees of heat, and saturated with magnesium plus glycerol. These treatments, save the neutral air-drying, would alter the d-spacings or the thickness of each layer of the clay minerals in a predictable manner, allowing for mineral identification. XRD patterns were stacked on top of one another to look at weathering trends; stacked XRD patterns of limed and un-limed sites were furthermore compared side by side to look at differences in mineralogy and weathering.

The two most abundant clay minerals in the Adirondack were smectite and vermiculite. Smectite, the more weathered mineral, was found to be most abundant near the surface of the soil and gradually diminished in quantity deeper down the soil, where vermiculite became progressively more abundant. This kind of mineralogical transformation was expected since weather processes are typically most intense at the surface of the soil. There were no meaningful differences between the mineralogy and the mineralogical transformations of the limed and un-limed sites. This contrasted with a related study that investigated changes in soil chemistry between limed and un-limed sites—while there was little to no mineralogical differences within a decade since liming, there were significant chemical changes in Adirondack soil that had been limed. This study does not conclusively prove that liming has little to no impact on the clay mineralogy, however. Ten years may simply be too little time for minerals to transform and for new minerals to develop. A future reassessment of soil samples from the sites is recommended. Determining the specific timeframe in which such geologic processes operate would be beneficial.
Title of Project: Colgate’s Bicentennial: A History of West Hall

Project Summary:

After the thirteen men with thirteen dollars and thirteen prayers founded the Baptist Education Society of the State of New York in 1817, which would morph and grow into Colgate University, the school was granted a charter in 1819. For these early years classes were held in the second floor of a building in the town of Hamilton on the present site of 38 Broad Street. It was not until 1826 that the Institution obtained the land now fondly known as Colgate’s campus. The first building was erected the following year, and still stands as the oldest on campus. West Hall, known by various names through its long past including Western Edifice and West College, has undergone drastic changes through its time. The aim of this project was to piece together the history of West Hall in an attempt to understand what it looked like through its many iterations. This information was then given to students working with resources from the VisLab, who then constructed virtual 3D models of West in its early years. These were rendered into life-like video walk throughs, which will become part of a video on the history of West Hall, which will contribute to the Bicentennial Project.

The interior of the building has been torn out and entirely renovated three times, with many smaller renovations in between. We do not have plans nor thorough documentation from all of these renovations. To construct images of the interior we had to piece together fragments of information from student newspaper articles, board of trustees minutes, reminiscences, and alumni news. When it was constructed, it was the only building on campus (along with a small building for meal time), thus it housed all of the functions of the college, including student rooms, classrooms, the library and a chapel. The West chapel was two stories, occupying the third and fourth floors. This chapel had an opening in the center of the fourth floor so those sitting on the third floor could hear the speaker. This building arrangement is a highly unusual one. With no pictures or floor plans, we had to discern what we could from various sources to figure out which way the chapel faced, where the stairs would have risen, and how the surrounding room’s doors opened into the chapel. We faced challenges such as this at every turn in reconstructing the original building.

Once we had settled on the most accurate possible reconstruction of West we began piecing together the 3D digital model video and images of artifacts from earlier years of West Hall for a video which will contribute to commemorating Colgate’s history as the 2019 Bicentennial approaches.
While many non-mammalian vertebrates have a regenerative capacity of some sort, Zebrafish have the remarkable ability to regenerate any damaged tissue type in their bodies. In order to study the signaling pathways responsible for regeneration in the retina specifically, I utilize a light lesioning technique to destroy the fish’s photoreceptors. I am interested in a particular signaling pathway called Notch Signaling which has been previously shown to be responsible for neighboring cells having different cell fates during development. By using a drug called LY411575 that inhibits Notch, I can study its effects on Müller Glial Cells (the cell type that divides in response to injury) which without drug treatment would each divide asymmetrically creating one progenitor cell that becomes a photoreceptor and one Müller Glial cell thus maintaining the parent cell population (Figure 1 and 2). The fish line Tg(GFAP:GFP) which fluorescently labels Müller Glial Cells was used in these experiments. The fish were raised in an incubator at 28.5°C and were lesioned after a minimum of 5 days of age to ensure full retinal development. The LY drug was administered at 10µM in E3 fish media.

In first rounds of experimentation with the LY drug, a very interesting phenotype of the Müller Glial Cells appeared. Control retinas that were lesioned but not drugged have many Glial Cell nuclei that are uniformly dispersed throughout the Inner Nuclear Layer (Figure 1). When LY was administered 2 hours post lesion there were far fewer Glial Cells in their expected location and instead there were groupings of proliferating cells in the photoreceptor layer.

LY works as a secretase inhibitor. Normally, juxtacrine signaling between two touching cells is responsible for their different cell fates because one cell’s notch transmembrane receptor’s intracellular domain is clipped by secretase allowing it to move into the nucleus and become a transcription factor. By prohibiting this process, LY essentially turns off Notch Signaling. In my following experiment, I was interested in when Notch Signaling is most active during regeneration post injury. There were eight groups that varied by the time the drug was administered and washed out in order to create a timeline. I quantified the number of Glial Cells and the number of proliferating clusters by taking photos on a Zeiss 710 confocal microscope. I predicted there to be fewer Glial cells and more proliferating clusters without Notch Signaling as a result of a change from asymmetric cellular division to symmetric. This meant that more cells differentiated as photoreceptors, diminishing the population of Glial Cells. The results from counting individual Glial Cells and proliferating clusters can be seen in Figure 3, which attempts to create a timeline for Notch Signaling. In the future, more fish will be used to determine if the results were statistically significant.
Title of Project: Digital Database of Linsley Fossil Collections and 3-D Printing of Colgate’s Dinosaur Egg

Project Summary:

Colgate is home to an impressive cache of fossilized specimens collected by Robert Linsley, a professor who taught at Colgate from 1955 to 1992. Beautifully preserved members of the phylum Mollusca (snails, clams, oysters, mussels) are stored in drawers behind a locked door in the basement of McGregory Hall, hidden from the public’s view. In order to shed light on our vast collection and make the fossils available to any interested online visitor, Prof. Soja decided to make a digital database displaying all that the Linsley Collection has to offer.

To start, each specimen from each of the drawers needed to be photographed using directional lighting set in such a way that the cracks, ripples, crevices and other unique features of the fossil were easily seen. As the pictures were being taken, information, such as genus/species identity, location found and age of the fossil, was recorded. The raw images were then uploaded into PowerPoint where they could be edited and saved in folders dedicated to each individual drawer. In this manner, the beginning of a digital database was born. Ultimately the goal is to have these images available online through the department’s website, effectively displaying one of our University’s great treasures.

Along with the Digital Database, I worked closely with another Colgate attraction — the famous, as well as infamous, Oviraptor egg. Colgate’s dinosaur egg is shrouded in history, a history that makes the egg worth far more than the $5000.00 Austen B. Colgate purchased the egg for back in 1924. To Colgate alumni who are familiar with the story of Colgate’s egg (which I will not elaborate on here), being able to own a piece of the story is a real privilege. In order to put the egg into the hands of past and present students/faculty and otherwise interested persons, I was tasked with creating a 3 dimensional replica of the specimen. Using Colgate’s new 3D printers, along with members of the ITS staff, we were able to render a high quality 3 dimensional scan of the egg and begin printing durable acrylic models. These models act as a viable teaching tool that may be used in classrooms or in private establishments, places where the real egg could, understandably, never travel.

During the printing of the egg, several hurdles needed to be overcome. First, the actual egg could not be scanned due to its delicate and high-value nature. Instead, a plaster cast was used as the base for our scans. Later, after printing our first small scale eggs successfully, it was time to create the full size replica. Due to the dimensions of the object, as well as small imperfections in the scan, our egg would be knocked off balance part way through the printing process, forcing us to start over. This happened on several occasions until, using design software, we were able to add additional supports to the egg as the print began to build up. These supports would later be removed from the egg, yielding a final true representation of an object so intertwined in Colgate’s history.

Economics literature provides evidence that substitutability between foreign and native-born workers plays a role in determining the changes in wages from immigration. Further, evidence also suggests that substitutability arises because immigrants and natives work in different types of occupations, thus requiring different skills.

The legal status of immigrants might therefore play a role in determining the type of work performed and skills used by immigrant workers. Unfortunately, information on legal status is not available in widely-used nationally representative surveys such as the US Census, American Community Survey (ACS), or Current Population Survey (CPS). As one solution to this limitation, some studies have relied on the Immigration Reform and Control Act (IRCA) as a source of information. IRCA was passed in 1986 in effort to reduce the inflow of illegal immigration into the United States by introducing employer penalties for hiring undocumented workers and increasing border enforcement. However, it also offered amnesty that granted legal status to previously unauthorized immigrants who could verify continuous residency in the US since January 1, 1982.

This study therefore exploits a natural experiment created by IRCA to determine the wage and skill effects of transitioning to legal status for immigrants likely eligible for amnesty. We use 1990 and 2000 census data on foreign-born individuals who first entered 6-10 years prior to the survey. We compare Mexican immigrants who were likely subject to IRCA amnesty to Latin American and other immigrants who were less likely to receive amnesty. Exogenous policy change created by IRCA allows us to identify groups of workers likely to have acquired legal status. This facilitates triple-difference estimation to examine how legalization affects legalized immigrant wages and occupational skills.

Our analysis begins by exploring wage effects – a question examined by previous studies as well. We find that wage effects appear to exist but are small. Mexican-born immigrants who were likely eligible for amnesty through IRCA saw wages increase by 2.9-6.5%. The second part of our analysis is more innovative. We examine whether IRCA-induced legal status created an opportunity for immigrants to work in occupations more similar to those of native-born Americans. Our estimates again show that such an effect occurs but is small. Mexican-born immigrants who were likely eligible for amnesty through IRCA decreased manual skills associated with their occupations by two percentiles. They increased their communication skill use by 2.1 percentiles. These magnitudes are equivalent to 13% of the skill gap between native-born Americans and Mexican immigrants with a high school degree or less education. This suggests that legal status does help immigrants to pursue occupations more like those of native-born workers, thus increasing the level of labor market competition. The effect is small, however, and does not come close to reversing the comparative advantage of native-born workers in performing communication work.

Much of our analysis is focused on placebo comparisons of immigrant groups that should not be affected by IRCA (e.g., groups unlikely to have received legal status from IRCA). Null results in those regressions help in reassuring that our main results are indeed likely to be driven by IRCA-induced changes in legal status, and not omitted factors correlated with the policy.

Title of Project: *Klf4* null MEFs exhibit increased Rho-mediated stress fiber formation associated with migration

Project Summary:

Cell migration is a common process in development, wound healing, normal immune response, and it can also occur abnormally in cancerous cells. Migration is coordinated by changes in actin arrangement. The family of proteins called Rho GTPases is known to regulate actin arrangement. How these specific Rho GTPases are activated is cell-context specific and not well known. Krüppel-like factor 4 (KLF4) is a transcription factor that regulates genes involved in proliferation, differentiation, and maintaining cell tissue homeostasis. In our study, we aimed to investigate the role of KLF4 in migration and invasion by evaluating changes in actin filaments and expression of key proteins involved in cell migration.

*Klf4*, a tumor suppressor gene, is often mutated in colorectal, gastric and pancreatic cancers types. However, the underlying mechanisms are not well understood. From our research, we found that *Klf4* null MEFs exhibit higher expression of actin structures associated with migration as compared to wildtype. This finding indicates that the increased migration in *Klf4* null MEFs could be due to changes in actin arrangement. Specifically, we found that *Klf4* null MEFs express higher amounts of Rho, as compared to wildtype MEFs. Our data, indicates that KLF4 may act as a regulator of Rho expression so that cells with KLF4 inhibits stress fiber formation (Figure 1).

In order to evaluate the mechanism by which this occurs, we looked at two known pathways involved in cell migration: the PI3K/AKT and the TGF-β pathways. We found that both SB-505124 and Ly-29 inhibitors of TGF-β and PI3K/AKT respectively showed decreased stress fiber formation and Rho expression in *Klf4* null MEFs when compared to wildtype MEFs. Future experiments will determine the expression of Rho in cells null for *Klf4* by reexpressing the gene via transfection. Furthermore, using RKO cells derived from a known human colon cancer line the relationship between Rho and KLF4 can be demonstrated in a way that is relevant in humans and conserved among species.

Lastly, while movement across 2D surfaces closely resembles migration, it does not encompass the complex process of invasion, a potential precursor for cancerous cells. In order to assess whether *Klf4* null MEFs exhibit invasive properties, 3D invasion assays containing a collagen basement membranes should be used to mimic the movement of cells from one tissue layer into another. If *Klf4* null MEFs show increased invasion, differences in actin arrangement and expression of Rho in the isolated “invasive” cells would be crucial in proving the importance of KLF4 in preventing cell migration and invasion.

![Figure 1: Basal level KLF4 null MEFs express increased migratory actin arrangements as well as increased Rho and S6K levels as compared to wildtype MEFs.](image)

**Source of Support:** □ AHUM Div. □ NASC Div. □ SOSC Div. □ UNST Div. □ Other (specify): Michael J. Wolk ’60 Heart Foundation
Title of Project: Field School Fellow with the Mohawk Valley Resource Center for Refugees

Project Summary:

This summer, I worked under the Volunteer and Intern Coordinator, Jennifer Cieselwitz at the Mohawk Valley Resource Center for Refugees. This is one of the foremost refugee centers in the country because the building itself houses all of the services resettling refugees need in their first few months. More commonly called the Utica Refugee Center, we resettle about 500 people a year who have come from violent humanitarian conflicts across the globe. We have resettled over 15,000 refugees who now make up about 17% of the city’s population. MVRCR has many offices that complete the tasks of finding housing for all resettled refugees, finding all new refugees jobs, enrolling children in school, teaching English for free, beginning the Naturalization process for all new refugees, translating for people across the community, as well as many other tasks. Because there are so many tasks to complete and clients to help, the staff of the Refugee Center is always over-scheduled and the volunteer office is always disorganized.

I was one of many interns at MVRCR. We all were assigned different projects to complete, many of which were thinking about new programs that we could implement to help the new citizens that are our clients. A partner and I were thinking about ways to facilitate and encourage donations to MVRCR that might lead to greater community involvement in aiding newly arrived refugees and MVRCR. We designed a program called “New Home, Utica,” a system inspired by other organizations’ donation efforts. This program would be entirely volunteer and intern organized because it would be easy to track and verify the donations online between a various number of people.

We envision using Amazon.com to construct a “Wish List” containing many of the items newly arrived refugees most frequently need. These items would be listed by priority, price, and quantity needed. Any donation made on the MVRCR Amazon Wish List would be delivered directly to MVRCR. If the benefactor chooses to disclose their identity, we will automatically send them a thank you message and tell them about the difference even a small donation makes. By potentially creating a tiered system of levels of recognition for different sized donations, we could begin dialogue between the welcoming Utica community, MVRCR, and our newest community members. We would focus on single arrivals and small families (with no contacts in the area) as the primary recipients of these donated goods so that those new arrivals who need it most could begin their Utica experience with more money in their pocket. This program would also mean that the MVRCR staff has to spend less time gathering goods for these new apartment setups. To put it simply: everybody wins.

I also worked in the office doing a bunch of different things. I manned the front desk on multiple occasions and had the opportunity to interact with many refugees. I worked at the translation office, Compass Interpreters, and heard the stories of many people there. I organized events to reach out to the Utica population. I created a list of all of the restaurants and religious institutions in Utica and met so many interesting and important people in the community. So, while I did not do a lot of research or actually create the program I proposed, I had a great time learning about the refugees and the area of Utica. I will continue volunteering at MVRCR this semester in hopes that I can write a grant that would allow for this program to be established. I am so grateful for this opportunity and hope that my involvement in the future will be as fruitful as this summer was.
Research Fellow: Shunong Sun (2018)  
Concentration: Undeclared

Faculty Mentor: Julie Dudrick  
Department: Upstate Institute

Title of Project: Field School Fellow with the Community Action Partnership and Upstate Institute

Project Summary:

I was asked to create a short video as an overview of the work that the Community Action Partnership in Madison County, NY does for marginalized populations in our county and beyond. This video will be used mainly for fundraising and for introducing CAP’s work to the general public. Additionally, I worked with Julie Dudrick to conduct a series of interview clips with 13 local organizations who regularly work with students about best practices of conducting community based research.

For CAP, I used selections of pictures, which are effective in presenting the main activities of CAP. I also include a background audio that will help the audience to better understand what CAP has done during the past few years. After gathering related information by interviewing CAP’s program directors and reading sufficient reports and paperwork, I interviewed three staff members who has worked at CAP for a very long time and has great stories to tell. I conduct three separate interviews with them and edited all the clips into one short film, which tells people how they feel about working in CAP and what they think people need to know about poverty in Madison County.

As for the interview project, Julie Dudrick and I conduct weekly interviews with one or more local organization. Before each interview, we sent basic instruction to the interviewee about specific topic. When conducting the interview, we asked the interviewee to talk about their expectations of students, their understanding about Upstate Institute projects and their suggestions to student interns. Afterwards, I edited each video clip into a 2-3 minute short interview with FinalCut Pro. At the end of summer, Julie and I will make all the clips into a video series for future use.

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

In the summer of 2015, I spent ten weeks working as a student paralegal at the Legal Aid Society of Mid-New York (LASMNY). LASMNY is a not-for-profit law office that provides civil legal services to low-income people in Oneida County. These legal services include providing legal information, advice, or representation in cases involving public benefits, healthcare, consumer and debt problems, housing, education, employment, family matters, immigration, etc. In the context of bankruptcies, people sometimes need a fresh financial start because they have accumulated serious debt after a long illness, leaving an abusive ex-spouse, or an accident that affects their ability to earn as much as they used to. The irony of bankruptcy is that it is not cheap to do so. It costs $335 to file for bankruptcy, and attorney fees from seeking legal advice can run into the thousands. LASMNY takes on clients who make under 150% of the poverty line and carries out the following process:

- Where the bankruptcy case is brought to
- If successful, all debts and prior financial obligations are cancelled, with the exception of taxes, alimony, child support, and student loans
- Takes a case that is already completed and organized, and prepares to represent the client for free in bankruptcy court
- Completes bankruptcy case
  - Sends it off to a private attorney
- Screens people who reach out to LASMNY based on eligibility requirements
- Establishes that filing for Chapter 7 bankruptcy is the best solution for the client’s problems
- Completes bankruptcy case
  - Sends it off to a private attorney
- Submit all bills and statements
- Clarifies questions LASMNY might have
- It is the client’s responsibility to correctly remember their own debts; if there is something that is not listed, it will not be discharged

All individuals filing for Chapter 7 bankruptcy also have to complete credit counseling, which is done through certain accredited online programs. This can be a fairly complicated process, so many clients choose to come in to LASMNY to get assistance with the counseling session.

(What it means to "complete a case"
- Taking the client’s papers in order to create a big picture of the client’s financial situation—which includes figuring out the exact extent of his/her:
  - unsecured debt (e.g. credit cards)
  - secured debt (e.g. houses, cars)
  - monthly income
  - expenses
  - assets
- Organizing all of this information into easy-to-read forms using the FastCase TopForm software
- Writing a memo to the private attorney that not only succinctly summarizes the client’s situation, but also argues why the private attorney should take up this pro bono case (e.g. the debt is presently causing the client a lot of problems, and the debt was beyond the client’s control)

Project Summary:

Over the course of the summer I continued assisting with the research I had originally started in the fall of 2014. The purpose of the research was to analyze samples taken from various depths of marine sediment off the coast of southwest Greenland to track the ice’s history of retreat after the end of the last ice age. I collected data that could differentiate the sources of sediment in the core—did sediment come from Greenland, Iceland, or North America? This information can tell us where ice was melting or calving, and therefore where ice was retreating. Given the time frame of the research, data gathered from my research can only be considered preliminary. However, there are trends within the data that suggest sediment sourcing from Greenland. This interpretation supports a previous study that shows that Greenland may have experienced considerable melt just after the end of the last ice age.

The primary means of sample analysis was x-ray powder diffraction (XRD). Core samples were powdered and mixed with a proportional corundum standard and then processed via XRD. The XRD scans of the samples were later analyzed through the RockJock software program in Microsoft Excel. RockJock allowed for a detailed mineral analysis of the various mineral peaks that were picked up by the XRD process. With this analysis I was able to selectively search for various minerals within the samples in the hopes of finding various trends that may indicate events in the ice sheet, such as the presence a large surge of meltwater. I found that the mineral assemblages are consistent with a Greenland source, and future work will distinguish between regional Greenlandic sources.

An additional means of analysis used was the counting of individual grains of sand taken from the sediment core in order to obtain the percentage of volcanic ash, most likely originating from Iceland, within the samples. The presence of ash is an indication of iceberg rafting taking place along the Greenland coast after the ash was deposited onto east Greenland ice by volcanic eruptions. If iceberg rafting from east Greenland was common, then a Greenlandic sediment source does not necessarily indicate ice melt. Rather, it indicates increased calving, which could be a result of either ice advance or retreat. More data needs to be collected in order to determine whether increased iceberg rafting coincided with the deposition of Greenlandic sediment in the studied sediment core.

☑ Other (specify):  Hackett-Rathmell 1968 Memorial Fund
**Title of Project:** Field School Fellow with Madison County Cultural & Heritage Tourism Committee

**Project Summary:**

This summer I have been working with Madison County Cultural and Heritage Tourism (MCCHT) committee. One of the objectives of MCCHT is to direct more efficient allocation of funding and resources to the promotion of the county’s cultural heritage tourism. To this goal, MCCHT is conducting an economic impact study project to provide evidence of economic relevance of cultural heritage organizations in the county. I am helping MCCHT with this project, and my work involves finalizing the gaps from the data collected from different arts and culture institutions, analyzing the data, writing a summary report, and preparing promotional and marketing materials for MCCHT.

Our findings show that nonprofit arts and culture is a $4.64 million industry in the Madison County. We estimate that this represents 0.27% of total output (GDP total of all industries) of the county. In addition, the arts and culture industry, directly and indirectly, supports 100 full-time equivalent jobs, which accounts for 0.47% of the county’s total employment, contributes $2,272,778 in resident household income, and generates $455,614 in local and state government revenue each year. To conclude, this study proves that investing in the arts and culture delivers economic benefits for all stakeholders in the local community.

Eighteen nonprofit arts and culture organizations in the county – museums, theatres and art galleries, historic parks and sites – participated in our survey. The study follows the model of Arts and Economic Prosperity IV, a similar but national-wide economic impact study conducted by Americans for the Arts, the nations’ leading nonprofit organization for advancing the arts and arts education. The table below summarizes the major findings in this study. Data presented for other study regions are obtained from Arts and Economic Prosperity IV National Statistical Report.

**Source of Support:**

- [x] AHUM Div.
- [ ] NASC Div.
- [ ] SOSC Div.
- [ ] UNST Div.
- [x] Other (specify): Upstate Institute
Research Fellow: Sydney Thompson (2017)  Concentration(s): History; Environmental Studies

Faculty Mentor: Julie Dudrick  Department: Upstate Institute

Title of Project: Field School Fellow with The Impact Project

Project Summary:

The main motto of The Impact Project is to “save a soul one house at a time”. The Impact Project is in its eleventh year of helping homeowners, having just completed their 73rd project and hitting the two thousand mile-marker for volunteers. For eleven years The Impact Project has grown into an organization that no one thought possible and it only continues to develop as it extends into more counties, partners with new organizations and gets the word out to the increased number of homeowners in upstate New York that have been struggling due to the lack of economy, increased flooding and harsh winters. The Impact Project relies heavily on grant funding and private donors to ensure that they can help as many homeowners as possible. The organization aims at creating sustainable environments for each homeowner, particularly the low-income and elderly, in order to establish a better quality of life for them at the present time and for years to come. Whether it is putting on an entire new roof, building a handicap ramp, or installing a furnace, when The Impact Project is done with a particular project there is an increased sense of hope and establishment within each homeowner.

The only things typical at the impact project are trailers with leaky roofs. Everyday presents a new challenge, a new obstacle to grasp and a new piece of the puzzle to solve. We sort through application requests daily, as well as completed applications that make their way to the review process where a Board of Directors carefully examines each case to establish who the organization is able to help. Planning each project takes a great deal of time and effort so that when the day comes to execute the project everything runs smoothly. During my time with The Impact Project I was able to see first hand the struggle that many Upstate New York homeowners go through on a daily basis. A large part of this struggle has to do with the amount of senior age people living in the area. The significant increase in percentage of senior age people in Upstate New York has to do with the Baby Boom, as well as much of the work force (ages 25-40) leaving the area. By the year 2025, the youngest of the Baby Boomers will be in their early 60s. These people will have little family in the area, as well as limited resources in order to solve their own problems, because of the lack of economy and work opportunities in the upstate NY.

Among similar organizations, the Impact Project is unique in that applicants receive a decision pretty quickly and from there accepted applicants do not have to worry about waiting many years for their projects to get done. Simply put, the Impact Project wants to help as many applicants obtain sustainability as they monetarily and physically can. However the demand never seems to diminish as the population of Upstate New York is highly skewed to the older side and those folks have little family in the area and no means to solve their own problems. This seems to be the biggest challenge, picking whom to help. Out of so many viable applications that come in every month, there can only be about one project and that is the most difficult part of the job.

☑ Other (specify): Upstate Institute
Project Summary:

This summer, I worked to understand and create a video about the history of West Hall, the oldest building on Colgate’s campus. This project was done as part of the Colgate Bicentennial Project effort. Professor Petrulis was my faculty mentor, but we also worked with Professor McVaugh and his student researcher from the Art History department as well as Joe Eakin and his students from the Ho Tung Visualization Laboratory. The final goal of our work was to create a video that shows both the interior and exterior of the original West and shares the stories of the students and faculty who lived and worked there. We are planning to show the video to the Board of Trustees in October, so we have continued working on the project this semester to finish the video.

In order to make the video, we first had to find out what West looked like when it was completed in 1827. We gathered the majority of the information in the University Archives and from the online collection of student newspapers. We studied photographs, prints, plans, construction specification reports, and many different accounts and recollections of students and faculty in order to piece together an understanding of the building and the elements it contained in its early history. Since West was the only building on campus for a time, it used to contain space for all of the school’s functions except for dining. The chapel was one of the most interesting elements of the original West, so we wanted to highlight it in the video. However, there are no images and only very contradictory accounts of its appearance. Therefore, in order to understand it, we had to use small pieces of information from a variety of accounts to arrive at an idea of what it was like to be in the original chapel in West.

After we gathered our information, we created our own floor plans of the building using the architectural software SketchUp. This was important for two primary reasons. The first is that it allowed us to test whether all the rooms and elements like the stairs fit inside the measurements of the building (60 feet by 100 feet). This let us know when our ideas were not working and we needed to try something new, and we eventually were able to fit everything inside in ways that made sense. The second purpose was to provide a basis for the students from the Visualization Laboratory so that they could build detailed computer models of the exterior and each floor. These models will be the visual component of our video for much of the time. We also wrote a script that gives information about each room that the viewpoint “flies” through and shares stories and quotations from the recollections that we used to understand the space. We recorded three people speaking the script and have also found and recorded music and taken photographs to supplement the video.

At this point in the project, we are waiting for the computer model to be complete so that we can get the footage for the video. Once we have that, we will need to edit all the pieces together, and then after that we will be finished with the project. Working on this video about the history of West Hall for the Bicentennial has been incredibly interesting and rewarding.
Project Summary:

This summer, I worked in Alaska for Colgate's the Geography Department to examine the dynamics of permafrost, a layer of year-round frozen soil that underlies the terrain of the far Northern regions of the globe. Rapid changes in global climate greatly affects the depth and stability of Alaska's permafrost, which requires thorough study in order to understand how these changes may feedback into global climate change and how they may affect the Alaskan landscape. In this project, I worked under Professor Loranty with two Colgate students and several researchers from around the country. We sought to examine how vegetation on the surface, such as trees, mosses and shrubs, affected the depth of soil thaw and thickness of the organic soil layer during the summer. Vegetation affects many physical characteristics of an ecosystem, such as the amount of shade or the how long snow lasts into the Spring, and thus can be a major factor for how deep soil thaws during the summer, which determines the upper limit of permafrost.

We carried our this investigation by measuring the soil layers of each study site and characterizing aboveground vegetation biomass and plant community composition. We conducted this study in various sites in central Alaska, along the Dalton Highway, and around Toolik Lake Field Station and Deadhorse above the Arctic Circle. In each of the twenty-four boreal forest and tundra sites we studied in Alaska, we measured thaw depth and organic layer depth along three 20m transects; thaw depths was measured every meter, and organic layer depth every five meters. Whenever it occurred, we also measured the depth of the mineral soil layer underneath the organic layer before hitting frozen soil. Aboveground vegetation along these transects was characterized by measuring tree diameter-at-breast-height (dbh), the dimensions of tussocks, which are dense clumps of grass that rise on mounds above the soil, and the amount of woody debris. At the ends of these transects, we measured the percent cover of different plant functional types in 1mx1m quadrats. For each quadrat at the 0m end of a transect, we harvested live biomass from one quarter of a quadrat. At the ends of these transects, we also sampled the organic soil layer and (when it occurred) the mineral soil layer.

Samples taken from the field were processed in the lab at Toolik Field Station and at the University of Alaska Fairbanks campus. Biomass samples, separated by functional type, were dried and weighed for dry biomass. Subsamples of these biomasses were sent to Woods Hole Research Center for further analysis. Soils and coarse roots were sorted from each other and dried and weighed for dry biomass. Some of the dried soil samples were then sent to Woods Hole Research Center in order to measure the carbon and nitrogen content of the soil. The other dried soils were burned in a muffle furnace in order to measure the loss of organic matter upon ignition.

From the research conducted in this project, I carved out my own independent project that investigates correlations between the degree of heterogeneity of active layer depths, organic layer thickness, and aboveground vegetation to determine how these facets of Northern ecosystems interact at the ecosystem scale. While the main project studies permafrost dynamics across the state of Alaska, I am trying to observe trends in the microtopography of the permafrost table. I submitted an abstract of my project to the American Geophysical Union so that I may be considered for a presentation of my findings at the AGU conference in San Francisco in December.
For three weeks in June/July, a Colgate Geology team, including myself, conducted field work in the Galapagos Islands. Typically one would connect the Galapagos to biology, but they are also volcanically active. During our stay along the equator, we sailed to two uninhabited islands to collect basalt samples. These remote locations in difficult terrain provided a challenging but rewarding experience. Using resources back at Colgate, the lava rocks we collected from Fernandina and Espanola can be analyzed to answer questions about the Galapagos volcanic system.

Fernandina is the most active Galápagos volcano, and is located closest to the seismically defined hotspot. Allan and Simkin (2000) observed that the subaerial edifice is constructed of homogeneous basalts (Mg# = 49 ± 2) with highly variable plagioclase phenocryst contents and sparse olivine. Geist et al. (2006) proposed a magmatic plumbing system in which the volcano is supplied by interconnected sills, the shallowest of which is density-stratified: olivine and pyroxene are concentrated at greater depths, whereas less dense plagioclase mush is higher in the sill. Consequently, olivine-rich lava erupts laterally during submarine events, but plagioclase-rich lava supplies subaerial vents. To test this hypothesis, we examine lavas erupted in 1995, 2005, and 2009. These SW flank eruptions emerged alternatively from en echelon radial fissures on the lower flanks and circumferential fissures near the caldera rim. The 1995 radial fissure unzipped downslope and then formed a cone 4 km from the coast, sending flows to the ocean. In 2005, circumferential fissures erupted five flows south of the 1995 fissure. As in 1995, the 2009 fissures opened down the SW flank before focusing to a cone near the 1995 vents, producing 6 km-long flows that also reached the ocean. By correlating plagioclase crystal size distribution and morphologies with single event chronological sequences, we examine Fernandina’s magmatic plumbing system. Modal plagioclase in 1995 lava decreases (20% to <5%) throughout the middle eruptive phase. Early 2005 samples are nearly aphyric (Chadwick et al., 2010), with 1-2% plagioclase. The 2009 eruption has reduced plagioclase, similar to mid-1995 samples. Preliminary observations suggest that less plagioclase-rich mush is being flushed out during early-to-medial event sequences, whereas plag phenocrysts are transported more during later phases. Plausible plumbing dynamics suggest a zone of plagioclase-rich mush that is eroded and incorporated into radial fissure eruptions.

Research Fellow: Cynthia Vele (2017)  
Concentration: Spanish

Faculty Mentor: Julie Dudrick  
Department: Upstate Institute

Title of Project: Field School Fellow with Young Scholars Liberty Partnership Program at Utica College

Project Summary:

The Upstate Institute granted me the opportunity to work as a Summer Field school Fellow with the youth of Utica: a largely migrant-populated community. I came into this job knowing that education was not as accessible as one might assume, and for those children that come from refugee families, families with less schooling, etc., it is close to impossible. In a society where meritocracy has been proven myth and those with social, economic, and political privilege are given preference over other groups, these children have always had to deal with the odds being against them. Luckily, organizations like the Young Scholars Liberty Partnerships Program have been created to cater to the needs of these children who lack the necessary resources and opportunities that other more affluent children tend to have. This issue is a systematic one and cannot be solved by simply investing money into programs and yet it is most definitely a step in the positive direction. The Young Scholars LPP provides summer schooling by college professors, opportunities for early college visits, homework help, community service opportunities, mentorship etc., as early as the sixth grade. The select group of students from both Donovan Middle School and JFK Middle School receive these benefits until they reach their senior year at Proctor High School. The purpose of this program is to ultimately provide support for the student until he/she graduates and to make higher education possible through scholarships given by the Community Foundation specifically for Young Scholars graduates. My job at the Young Scholars office located at Utica College was to investigate how many of these alumni received a degree(s) in higher education after graduating from Proctor.

Initially, I struggled with figuring out ways in which I could gather evidence of college completion and degree verification. I had used methods such as emailing different universities that abided by the FERPA law stating that certain student records can be given upon request. I had also turned to using social media such as Facebook and LinkedIn to contact alumni and acquire information directly from the student. However, the most convenient form of gathering this information was through the National Clearinghouse, which held these exact records. Along with personal record organizing and creating graphs, I was involved in helping out during the summer program whether it meant hands on assistance or office work at UC. Students in 6th to 8th grade must remain over the summer and take classes not offered in high school. This year, students conducted their own research and modeled a college-type science fair for their presentations.

Young Scholars provides family support and hope beyond high school. With the data I collected that confirms the impact that Young Scholars has on their future, the program is ensured donations from different organizations like the Community Foundation for years to come. I thank the Upstate Institute for giving me the opportunity to work with such resilient youth.

Source of Support:  
☐ AHUM Div.  ☐ NASC Div.  ☐ SOSC Div.  ☐ UNST Div.  
☒ Other (specify): Upstate Institute
Aspartic acid is the 44th amino acid in the amino acid sequence for wild type $\beta$-Carbonic Anhydrase in H. Influenzae (HICA). Because of its position, this particular aspartic acid, plays a significant role in the catalytic activity of HICA. In this study, the aspartic acid, a polar amino acid, at position 44 in the amino acid sequence was changed to glutamic acid, another polar amino acid, to observe how critical the aspartic acid is to catalysis. The catalytic activity of this mutant was tested using kinetics studies. The results of these studies yielded extremely low levels of catalytic activity, suggesting that the aspartic acid at the 44th position in the amino acid sequence is critical to the catalytic activity of HICA.

Carbonic anhydrases are metalloenzymes that catalyze the interconversion of carbon dioxide and bicarbonate:

$$\text{CO}_2 + \text{H}_2\text{O} \rightleftharpoons \text{HCO}_3^- + \text{H}^+$$

Currently, five different classes of carbonic anhydrases have been identified. The “type II” class includes $\beta$-carbonic anhydrases which are found in plants and eubacteria. In general, $\beta$-carbonic anhydrases function as zinc metalloenzymes. It is hypothesized that $\beta$-carbonic anhydrases can achieve two different conformation states: an inactive T state and an active R state (Fig. 1.)

![Figure 1. The conversion between the T state and the R state of a carbonic anhydrase.](image)

In order for $\beta$-carbonic anhydrases to work as efficient catalysts, they must be in the proper conformation (R state). The conformation of the R state relies heavily on the protein’s primary structure. The 44th amino acid in the $\beta$-carbonic anhydrase gene, aspartic acid, has been found to play a role in the conformation of the protein while in the R-state. To test how critical the aspartic acid at position 44 is for catalytic activity, a point mutation was introduced at the 44th position, changing the aspartic acid to glutamic acid.

The procedure for this experiment is outlined below:

- **Designing a Megaprimer:** three oligonucleotide primers and a DNA template containing the section of the gene to be mutated were used for this method. During the first PCR run, a fragment of the DNA plasmid containing the mutation (D44E) was synthesized and amplified. This fragment was the megaprimer.

- **MEGAWHOP:** The MEGAWHOP (Megaprimer PCR of Whole Plasmids) allowed for the cloning of DNA fragments into a vector. The complete HICA D44E plasmid was synthesized and amplified from this PCR run. To reduce any template DNA that remained, DpnI was added to the HICA D44E plasmid.

- **Transformation of Mix N' Go Cells:** the HICA D44E plasmid was added to E. coli cells (JM 109)

- **Protein Overexpression:** A large culture of E. coli containing the mutant plasmid were grown up and their protein contents were collected.

- **Protein Purification:** The desired protein (HICA D44E) was collected from the batch of crude protein obtained from the cells. Three purification techniques were used: Ion Exchange Chromatography (IEX), Hydrophobic Interaction Chromatography (HIC), and Gel Exclusion Chromatography (GEC).

- **Kinetics:** To test the catalytic activity of HICA D44E, a stopped-flow spectrometer was used. The stop-flow spectrometer measures the rate of CO2 hydration.

- **Protein Crystallization:** to examine the structure of HICA D44E, the protein is crystallized. Using various crystallizing conditions, a protein crystal of HICA D44E is synthesized

The HICA D44E mutant was successfully synthesized and obtained. Kinetics studies revealed that HICA D44E exhibited extremely low levels of catalytic activity, suggesting that the protein is inactive. The max kcat value for HICA D44E was determined to be approximately $1 \times 10^3$ sec$^{-1}$ whereas the max kcat value for HICA was found to be approximately $69 \times 103$ sec$^{-1}$. The catalytic activity of HICA D44E is no greater than 1% of the catalytic activity of HICA wide type. Because HICA D44E was inactive, it suggests that the aspartic acid at position 44 is extremely crucial to efficient catalytic activity. This finding poses new questions for the D44E mutant: is the D44E mutant confined to the T state, or is the D44E mutant able to attain the R state but unable to bind to the substrate? Successful crystallization of the D44E mutant would provide a deeper understanding of its structure and how its function is affected.
The main goal of this research is to see whether legislative posts are used as stepping stones and momentum generators for greater political power. And if fact they are, then what are the origins and agendas of these candidates. If election winners of a particular region have similar organizational affiliations, then this could show which organizations are the political powerhouses of that said region.

This summer, I worked on compiling lists of candidates running for representative positions in regional and local legislature elections using the Russian government’s official election database (http://www.izbirkom.ru/izbirkom/calendar/). This website gave me access to the complete list of independent and party-affiliated candidates, along with their personal information such as: age, education level, party affiliation, occupation(s), temporary deputy posts, and their candidate election registration status. The compiled lists ranges from elections as early as 2004, all the way up to 2014. Once this is done, these legislative elections will be compared to the nearest corresponding future regional or municipal executive elections. Through this comparison, it would be easy to see whether or not legislative posts act like stepping stones for future executive positions.

If this stepping-stone hypothesis is found to be true, it will then also be possible to find out which organizations, companies, and affiliations are vying for and/or winning political control in various regions of Russia using the candidates’ personal information and election registration status. The election registration status shows who is capable of going through the registration process to get on the voting ballot, and it could also show a pattern of which candidates (and the organization that support them) are being denied registration. It is hypothesized that this will allow for us to see the true political power holders of Russia.

1) It may seem odd to compare regional and municipal elections considering that it may seem that regional positions sound more powerful. However, municipal positions can have considerable power in large cities (Moscow, St. Petersburg, etc.). Because only larger cities have a lot of power, we only looked at municipal elections in cities with populations greater than 200,000 people.

Research Fellow:  Ha Vu (2017)
Concentration:  Mathematics

Faculty Mentor:  Evelyn Hart
Department:  Mathematics

Title of Project:  Developing an algorithm to calculate the Nielsen number for the double torus

Project Summary:

My research is associated with Nielsen fixed point theory—a branch of mathematical research in topology. I explored the math research process, from studying existing research and writing codes to test cases to making conjectures and proving them. I gained more confidence in coping with difficult math problems, completed a publishable result, and made progress on another project.

The Nielsen number is a lower bound of the number fixed points over continuous deformations of a mapping from a topological space to itself. Using the fundamental group, we studied ways to develop algorithms to calculate the Nielsen number of any given mapping $f$ on the double torus.

Each mapping $f$ induces a homomorphism $f^* : \pi \rightarrow \pi$ on the fundamental group. Existing research describes the complete Fox Trace based on the homomorphism, which is essential in calculating $N(f)$.[2] What is left unsolved in the process of finding the Nielsen number is identifying Reidemeister equivalences among the terms in the Fox trace.

Our research extends existing techniques to find Reidemeister equivalences, and develops complete algorithms to calculate $N(f)$ for some specific categories of homomorphisms. I wrote computer code in Python to help us develop conjectures.

By the end of the summer, I proved, using mathematical induction, the similarity between the Fox Trace in dimension 1 and Wagner front tails, which is a publishable result. I developed complete algorithms to calculate the Nielsen number for two categories of homomorphisms. The algorithms can be implemented using computers.

Works Cited:
http://mathworld.wolfram.com/UniversalCover.html

☐ Other (specify):
Project Summary:

The last three years have seen heightened interest in the capacity for MOOCs (Massive Open Online Course) to serve as an alternative to an on-campus college course. This model has the potential to be successful at large research universities where there is sustained institutional support and significant resources. Comparatively, small, private liberal arts colleges pride themselves on small classes and high levels of interactivity among students and professors. At institutions such as these, there is a desire to supplement classes with online technology rather than to replace them. We researched a pedagogical experiment conducted at Colgate University in which we explore the potential of adapting MOOC technologies and methodologies to enhance the educational mission of liberal arts institutions.

The experiment was conducted on a course called The Advent of the Atomic Bomb, which fulfills the Scientific Perspectives on the World requirement as part of Colgate’s core curriculum. We, along with three other students from the class of ‘17 served as course developers during the Spring 2015 offering. Since 1998, the instructor (Karen Harpp) has supplemented this course by having students engage in online discussions with Colgate alumni to infuse the course with a broader set of perspectives. In 2014, Harpp used the open edX platform to bring all of the course material to the alumni who were integrated during the semester with the campus-based students in a SPOC (Small Private Online Course). Additional opportunities for interaction included videoconferences, an online timeline project, and a Twitter play, in which students researched historical roles from the atomic bomb project and re-enacted the period between Pearl Harbor and the dropping of the bombs.

In 2015, a second version of the course was offered, again exclusively to Colgate alumni. This iteration was designed to implement and test innovations adapting MOOC technology to the liberal arts setting. Major changes included: a) shortened video lectures (3-17 minutes) and the addition of comprehension questions to promote sustained engagement; b) establishment of discussion group cohorts to increase alumni participation in the fora; c) Fireside Chats, student-produced video presentations intended to encourage in-depth research into course content and to forge stronger connections between students and alumni; d) flipped classroom: on-campus students were required to watch the video lectures prior to coming to class, instead of receiving the content live as they did in 2014.

The results of our experiment have important implications for online education, specifically, the design and implementation of both MOOCs and SPOCs. Our data indicate that the dearth of human interaction commonly found in online education can be reduced through the addition of pedagogical techniques aimed at building communities. Based on our research, we believe integration of online education technology with liberal arts teaching methodologies has potential to benefit the design of future MOOCs and SPOCs, and to enhance educational opportunities at small colleges. Our primary focus in designing this course was that of humanization. Our experiment with The Advent of the Atomic Bomb illustrates that it is possible to take the ideals and values of a liberal arts classroom and integrate them into an online platform. In essence, our goal was to imbue Colgate into online education.

In a continuation of a project by Luna Zagorac and Zachary Weaver during the Summer of 2014, this summer I continued to investigate the energy intensity, brightness, and color variations as a function of time of the blazar 3C 454.3 at the Foggy Bottom Observatory at Colgate. A blazar is a compact quasar (quasi-stellar radio source) believed to be a giant elliptical galaxy with a super-massive black hole in the center. The gravity due to the black hole is so great that, as matter falls into the hole, it is expelled in two jets of particles. These particles produce photons in various ways, including synchrotron radiation produced by the acceleration of charged particles in a magnetic field. Normally for these objects, the orientation of one of the jets is along a line of sight from Earth to the object. As a result, these objects are extremely bright, even though they are located billions of light years away. These objects occasionally will go through periods of intense emission, or “flares”, meaning that their brightness sharply increases, and then exponentially decays to their “normal” levels of brightness. This multi-year study began with the beginning of a flare in June of 2014 for the blazar 3C 454.3 in optical wavelengths. Images of the object were taken with the Newtonian-Cassegrain 16” telescope and Star1 CCD camera system at Foggy Bottom Observatory from June 2014-February 2015, and began again at the start of the observing season in May 2015. The several month gap is due to the timing of the object being in the sky coinciding with when it is day at the observatory. These images were obtained over 109 nights in three color filters: R (red), I (infrared), and V (visual/green). In a continuation from last year, I also examined the error, methodology of reduction of data, and several other telescope diagnostic procedures that are required to obtain the best, most accurate data possible at Foggy Bottom Observatory. Below is a plot of the multi-year observation campaign, plotting magnitude (an astronomical unit for measuring brightness, where a lower magnitude corresponds to a brighter object) versus date, including error bars.

![3C 454.3 Optical Variability](image)

**Figure:** The optical brightness variations in the blazar 3C 454.3 during 2014-2015.

**Source of Support:**
- AHUM Div.
- NASC Div.
- SOSC Div.
- UNST Div.
- Other (specify):
Research Fellow: Haochuan Wei (2016)  
Concentration(s): Chemistry, Mathematics

Faculty Mentor: Jason Keith  
Department: Chemistry

Title of Project: Computational Modeling on Transition Metal-Ligand Covalent Interactions

Project Summary:

Recent studies have shown that metal-ligand covalent mixing is closely correlated to physical properties and chemical reactivity of transition metal complexes. This computational chemistry project aims to investigate the effect of geometric properties of bonding on metal-ligand covalency, specifically for Pd and Ti diphosphine complexes. We collect our computational data by modeling slightly different transition metal complexes, as well as their K-edge X-ray absorption with time-dependent density functional theory. The data is compared with its experimental counterpart from our collaborators.

How do we fundamentally describe the metal-ligand mixing mentioned above?

Perturbation theory has provided a theoretical framework for such mixing that deviate from an ionic, electron-transfer-only limit. It approximates the wave function that describes our metal-ligand interaction.

How can the geometric influence be quantified?

Under molecular symmetry assumptions, we are able to designate key variables for the geometric profile of each compound. These variables are shown in Figure 1.

What is K-edge, and what does it do in this scenario?

K-edge X-ray absorption spectroscopy is the spectroscopy for excitations from 1s orbitals of a particular element. Certain absorptions are expected if the compound is exclusively ionic, but a when a pre-edge feature is observed, its peak height serves as indicator of mixing between metal d and ligand p orbitals.

Calculation and Results

A set of Pd and Ti diphosphine species were optimized in terms of geometry, wave functions and chemical potential. K-edge absorption was calculated and normalized to give the X-ray spectra in Figure 2. The first feature in each of the following spectrum shows the pre K-edge absorption, whose intensity demonstrate the relative strength of covalent interaction. Regarding the geometric variables, we look to obtain more K-edge data, to help quantify covalency in a mathematically more rigorous manner.

![Figure 1](image1.png)  
Variables that describe the local geometry

![Figure 2](image2.png)  
Left: experimental spectra (solid curve), calculated peaks (vertical lines), and calculated spectra (dashed curve). Right: geometry of the compound corresponding to each spectrum.

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

The Church of Jesus Christ of Latter Day Saints, commonly referred to as the Mormon Church, has fought to create an American identity since Joseph Smith’s discovery of the golden plates in 1823. The Church’s inclusion into the religious, and especially Christian, fabric of the nation hinged on both the inward relation of the Church to its people and the outward relation of the Church to the national government. Mormonism clashed with the Christianity practiced by most Americans in the 19th century with its religious tenets such as the establishment of the holy city of Zion, the practice of polygamy in the late 19th century, and a hierarchical structure that resembled a burgeoning theocracy. Through interactions with the federal government in the early 20th century, the Church weathered most of these challenges, in large measure by accommodating itself to the demands of the broader American culture. Their next challenge arose in solidifying this negotiated identity within the Church itself, leading to pageants both celebrating and reinvigorating the history of the Church consistent with its newly minted American identity. The annual Hill Cumorah Pageant, held in Palmyra, New York, provides a case study of this theatrical presentation of identity to audiences comprised of both members of the Church, for internal reification, and non-members, as historical education. The Pageant began in its earliest form in 1937, with the version in use today developed and recorded in 1987. It celebrates the history of the location of the Hill Cumorah in relation to the Book of Mormon, telling its stories and culminating in a reenactment of Joseph Smith’s revelation of the golden plates containing the scripture under a rock on the Hill itself. My research consisted of familiarizing myself with the history of Mormonism and its interactions with the American public, culminating in several attendances of the Hill Cumorah Pageant. At the Pageant, I conducted interviews of the cast, encouraging them to investigate their identities in the Church and its relation to the formation of their identity. My combined research of religious theory, Mormon history, and performance studies drew me to conclusions about the relationship between the Pageant’s theatrical and religious elements and Mormon American identity. The Church’s use of features such as a recorded script and score for the production elucidates the Pageant’s role in securing a particular Mormon American religious identity internally. In an ongoing cycle, the history of the Church makes the uses of the Pageant clear, which in turn solidifies the history of the Church for its members.
Title of Project: Laboratory Design and Development

Project Summary:

My research fellowship at Colgate comprised of visualizing, designing, and testing my own laboratory exercise, and redesigning/developing two other existing laboratory exercises all for the introductory physics course P111. In other words, I was told that I had to create a laboratory exercise meeting a certain set of guidelines concerning what information should be presented to the students, the physics concepts that they should take away from the laboratory after completing it, and in what way that information should be conveyed (for example, I had to create a lab that facilitates intuitive, hands-on learning about kinematics while utilizing specific tracking software).

Given these guidelines, I created a three-part progression that leads students through the process of building an understanding of the connections between the three main kinematic quantities (displacement, velocity, and acceleration), how they change over time, and how to generate their graphical representation. All three parts include the use of Tracker, a video analysis software that allows users to track the motion of moving bodies on video and analyze their motion. Once an object has been tracked on video, the software yields a myriad of graphs and data tables that the students can use to draw conclusions about the motion of the object and the forces that drive it. The three parts of the lab went as follows:

• **Level/Inclined Ramp**: In this part the students will first film and track the horizontal motion of a cart on a level ramp. Using the Tracker software, they will create plots of the cart’s x(t) and vx(t) motion and discover that displacement and velocity are related by their slopes; the instantaneous slope of the x(t) graph is the same as the magnitude of the velocity vector at that time for any given point on the graph. Next, they will film and track the motion of a cart rolling from rest down an inclined ramp. Again, using the Tracker software they will find that velocity and acceleration are related in a similar way.

• **Match That Graph**: In this part students will be given three unique graphs of motion, each displaying a different kinematic quantity, and will be asked to create a video of themselves moving back and forth along a line in order to recreate the given graph in Tracker. Although this part will certainly be more fun and will facilitate student’s creativity, it will also further reinforce students’ understanding of the graphical representation of kinematic quantities through hands-on problem solving.

• **Bullet Drop/Shot**: Finally, in this part students will explore first-hand how the physics works behind the classic question, “Which bullet will hit the ground first; one dropped or one fired horizontally from a gun, assuming they are both released from the same height simultaneously?” They will be asked to track the motion of two balls released from a ball launcher that mimics the motion in the bullet thought experiment, and from there draw conclusions about the dependency (or lack of it) between motion in the x and y directions, why the motion in the x and y directions are consistent with Newton’s laws, and how those things can help answer the bullet dropped or shot thought experiment.

Overall it was a great experience, and I recommend it to anyone who may be considering research!
Autophagy is a cellular process by which cytoplasmic components are recycled. Certain cellular stresses such as nutrient deprivation and oxidative stress have been shown to induce autophagy. Krüppel-like factor 4 (KLF4) is a zinc-finger transcription factor activated by oxidative stress to maintain genomic instability. Low membrane potential in dysfunctional mitochondria creates oxidative stress through the production of ROS (reactive oxygen species), in turn activating mitophagy—the autophagy of mitochondria. The protein PINK1 plays a major role in recruiting the machinery by direct interaction with dysfunctional mitochondria. In this study, we aim to understand the relationship between KLF4 and mitochondrial autophagy.

Two dyes were used in this study to visualize mitochondria of varying membrane potentials. The first dye is MitoID Mitochondrial Membrane Potential kit, which is a dual emission dye with the potential to emit two fluorescent wavelengths. In energized cells, the reagent exists as a green fluorescent monomer in the cytosol and also accumulates as orange-fluorescent aggregates in the mitochondria. However, in cells with compromised mitochondrial membrane potential, the reagent exists primarily as green-fluorescent monomers throughout the cytosol and no longer exhibits red/orange fluorescence in the mitochondria. What our findings suggest are Mouse Embryonic Fibroblasts (MEFs) null for Klf4 have more dysfunctional mitochondria and less functional mitochondria than Klf4 wild type (WT) MEFs. Under the column of MitoID green more intense green puncta are seen in the null cells whereas green fluorescence in the positive cells is generally evenly dispersed and less intense. MitoID red fluorescence is more prevalent and intense in the Klf4 WT MEFs. In the merges of these cell images, these patterns are consistent.

The second fluorescent dye we used in this study was TMRE (tetramethylrhodamine, ethyl ester) which labels active mitochondria. The dye is cell permeant, positively charged and accumulates in the active mitochondria due to their negative charge. Depolarized (dysfunctional) mitochondria cannot sequester the TMRE. Findings suggest the lack of active mitochondria in Klf4 null cells as seen by the low red fluorescence in comparison to Klf4 WT MEFs.

We then used Western blotting to detect levels of PINK1 and the effects of EBSS and the drug CCCP on the levels of PINK1 in Klf4 WT and null cells. PINK1 is a protein recruited to dysfunctional mitochondria, therefore we expected higher levels in null cells. CCCP is an uncoupler of the mitochondria. EBSS is a starvation/nutrient depletion serum known to induce autophagy. Our major findings were at basal level Klf4 null cells had higher levels of PINK1. When treated with the uncoupler CCCP, Klf4 null cells exhibited dramatically higher levels of PINK1 than in Klf4 positive cells, indicating accumulation of dysfunctional mitochondria in null cells but impairment of the autophagy process. EBSS treatment did not show any effects, likely because the incubation period was too short. We treated RKO cells with PonA an activator of Klf4. PINK1 levels decreased in the presence of PonA in these cells further indicating Klf4's necessity in autophagy but also suggesting a relationship with PINK1.

For the last part of this study, we overexpressed KLF4 in the null MEFs to determine the effect on PINK1. MEFs were transfected with GFP, KLF4-GFP or left untransfected. Cells were then fixed and labeled with PINK1 antibody and secondary antibody GAM555. Our major finding here was higher levels of PINK1 in null basal level MEFs, but less PINK1 in GFP-KLF4 transfected klf4 −/− MEFs than GFP transfected MEFs. This suggests the GFP-KLF4 transfection was successful allowing for the transcription of KLF4 and induction of mitophagy.

Results of this study demonstrate that Klf4-null MEFs exhibit impaired mitochondria at the basal level. With different drug treatments we found the levels of PINK1 are generally higher in cells without KLF4 than those with KLF4. This relates to impaired autophagy in KLF4 null cells as PINK1 tags dysfunctional mitochondria and those dysfunctional mitochondria are present in higher amounts in cells with impaired autophagy.
Title of Project: The Interclass Rivalry at Colgate University

Project Summary:

During the 1880s through the 1920s, the freshman-sophomore class rivalry was a prominent tradition at Colgate University. Freshmen and sophomores would spend the school year good-naturedly battling each other in annual events such as the Salt Rush, a salt-throwing match, and the Tug of War competition. The class that won each event would gain coveted bragging rights. Additionally, when the freshman class won, they also received special privileges in which they would gain certain freedoms from the official Freshman Regulations, which enforced the college’s class-year hierarchy. Many of the events that the interclass rivalry entailed were rather unusual, inspiring me to question their origins. I found that the rivalry customs were born out of a combination of many different factors, including changes in the student body’s interests, influence from other colleges, typical student mischief, and purposeful student and administrative planning. Unfortunately, the rivalry events were sometimes quite disruptive and even dangerous. Even so, alumni and students remained staunch supporters of the tradition. This dedication to a seemingly trivial rivalry caused me to question why it was so important to the Colgate community. Through my research, I concluded that students and alumni of Colgate University were so dedicated to the class rivalry tradition because they viewed the rivalry as a fundamental part of the Colgate experience and the University’s identity. They believed the rivalry fostered class unity, a sense of community, alumni dedication, and most importantly, Colgate spirit. From their point of view, Colgate University would be a completely different institution without these notable characteristics. Sadly, in 1919 a freshman died during the annual Proc Rush, a token freshman-sophomore class rivalry event, leading to the slow demise of the rivalry due to administrative intervention and waning student enthusiasm, causing the tradition to completely cease by the 1960s. Although the class rivalry tradition no longer exists at Colgate University, its impact is still noticeable and celebrated decades later, as the University continues to pride itself on its on the community, alumni involvement, and school spirit it helped form. I have created a website detailing the freshman-sophomore class rivalry that compiles my archival research in Colgate’s Special Collections and University Archives, provides evidence in context from many sources, and presents a conclusion rooted in this research and evidence.

Salt Rush, 1920

Tug of War, 1950s

Research Fellow: Anastasiya Yandulskaya (2016)  Concentration: Neuroscience

Faculty Mentor: Jason Meyers  Department: Biology

Title of Project: Role of Notch signaling in regeneration of lateral line hair cells in zebrafish

Project Summary:

Lateral line is a sensory organ in fish that allows fish to detect changes in water flow. It is composed of clumps of cells that are spaced out along the fish body from head to tail in a straight line. These clumps of cells are called neuromasts. Two of the types of cells in neuromasts are hair cells and support cells. Hair cells are mechanoreceptors that send signals to the brain when they are distorted by water flow. Support cells surround hair cells, providing support. The zebrafish lateral line hair cells are very similar to the hair cells in the human ear, except the fish hair cells can regenerate after injury, and the human hair cells cannot. Therefore, it would be interesting to uncover the currently unclear mechanisms of hair cell regeneration, as this information could potentially be used towards restoring hearing in humans.

During the first 48 hours of zebrafish life, clumps of cells are deposited from migratory primordium along the fish’s body. The leading end of the primordium is dominated by Wnt signaling, and the trailing end is controlled by FGF signaling. These cells clumps, called proto-neuromasts, eventually form a number of hair cell progenitors, and the rest of the cells become support cells. It is thought that a transcription factor called Atoh1 determines the fate of a cell as a hair cell progenitor. Notch signaling pathway is critical for allowing neighboring progenitor cells to differentiate into different cells, such as hair cells and support cells. Notch also suppresses expression of Atoh1. One possible model is that the central cells in a protoneuromast express DeltaA protein on their surface, which is a Notch receptor ligand and triggers Notch signaling in the neighboring cells. In these non-central cells, Notch inhibits Atoh1 expression, preventing them from becoming hair cells progenitors. In this way, only the central cells in a proto-neuromast can become hair cell progenitors (Chitnis et al., 2012).

For my research project, I focused on investigating the role of Notch signaling pathway in regeneration of lateral line hair cells. I manipulated Wnt and FGF signaling with drugs in 48-hour old zebrafish to convert all the lateral line cells back into migratory primordium. This method had been previously developed in Dr. Meyers’ lab. After two days, I washed out the drugs, allowed some fish to regenerate normally, and treated others with a drug that suppresses Notch signaling but still allows neuromasts to regenerate. I then used in situ hybridization with an mRNA probe for Atoh1. I conducted several trials to determine the optimal concentration of the mRNA probe for a successful in situ hybridization. Next, I found increased expression of Atoh1 in the neuromasts that regenerated with suppressed Notch, compared to those that regenerated normally or were left untreated. This data suggests that Notch may play an important role in regeneration of hair cells from the primordium.

As Atoh1 expression is important for formation of hair cells, the next important thing is to compare the number of hair cells in untreated neuromasts, those that regenerated normally, and those that regenerated with suppressed Notch. Using confocal microscopy and a fish transgenic line in which all hair cells are fluorescent, I obtained preliminary data suggesting that the mean number of hair cells is higher in both types of regenerated neuromasts compared to untreated controls. As part of my senior thesis research, I am working on obtaining more data for this question, as well as further investigating the role of Notch in hair cell regeneration in zebrafish.

☑ Other (specify): Michael J. Wolk ’60 Heart Foundation
Title of Project: Reconstructing the Gene Regulatory Network Governing Traveling-Waves of the Vertebrate Segmentation Clock

Project Summary:

Somitogenesis, the process by which somites (segmented tissue blocks that differentiate into skeletal muscle and vertebrae in vertebrate organisms) develop, is a biological process that is controlled by genes (his/her family genes) that show oscillatory (cyclic variation in time) mRNA and protein levels. These genes form the so-called somite segmentation clock, which controls the somitogenesis process. The zebrafish segmentation clock oscillates with a species-specific period in the posterior pre-somatic mesoderm (the precursor tissue from which somites are derived). The period of oscillations becomes longer as cells are displaced along the posterior to anterior axis, which results in traveling waves of clock gene expression sweeping through the unsegmented tissue. Although various hypotheses necessitating the inclusion of additional regulatory genes into the core clock network at different spatial locations have been proposed, the mechanism underlying traveling waves has remained elusive.

In Ay-Lab we investigate the systems-level emergent properties of the regulatory and signaling networks that govern the rhythmic pattern formation during zebrafish embryonic development. To that end, we utilize an interdisciplinary approach to combine experimentation with mathematical modeling to determine how the segmentation clock genes interact with other dynamically expressed genes in the tissue that results in anterior-posterior segment polarity and spatial pattern formation. In two previous studies in the Ay-Lab, it has been shown that a delay differential equation model for a core segmentation clock network can explain many features of the somite formation. The model of the gene regulatory network controlling traveling-waves of the vertebrate segmentation clock is essentially a delay differential equations model. This model contains genes like her1, her7, hes6, deltaC and their mRNA, protein products and dimers. The interactions of these molecules control the vertebrate segmentation clock. The model successfully examines how these genes interact with each other and, as a result, regulates the vertebrate segmentation clock. However the model fails to reflect some of the experimental observations.

The goal of my project this summer was to create a more comprehensive vertebrate segmentation clock network that provides a complete description of the zebrafish pattern formation process. To that end, I added two new genes (Mespa and Mespb) and their gene products into the previous model, for the Mespa and Mespb dimers are believed to affect the interaction of her genes. Firstly, I added new differential equations to the existing model to describe the transcription, translation and dimerization of the mespa and mespb mRNA, protein and dimers. To compare my new model to the experimental observations, I created new methods for calculating the oscillation features such as period, amplitude and synchrony. Initial model predictions are very promising and we can satisfy more than 20 experimental observations in seven different mutant genetic background. In the future we are looking forward to make new experimentally testable predictions for this system.
Project Summary:

At the core of the research I did this summer was the super conducting circuit element called a Josephson Junction. A Josephson Junction is a thin layer of superconducting metal, followed by an insulating layer, and finally another superconducting layer, forming a sort of superconducting sandwich. What's really interesting about Josephson Junctions is that despite there being the insulating layer between the two metals, super current can still flow across the junctions for currents less than a set amount, called the critical current. This occurs because the electron pairs that make super current possible can tunnel through the insulating layer at a fixed rate, and continue flowing once on the other side. As the current increases past the critical current, the electrons begin to arrive at the junctions faster than they can jump across and you get much more interesting behavior.

To be specific once electrons begin to pile up the equation that describes the voltage and current relationships in the junction becomes highly nonlinear with multiple coupled terms. This equation of state for a junction past the critical current, exactly mimics that of a damped driven pendulum, an equation of motion that is impossible to solve analytically. The power of Josephson Junctions is that they allow us to measure solutions to these highly non-linear differential equations that would typically be unsolvable without the use of a computer. Because of how quickly the junctions can settle into their behaviors, and how easily we can vary parameters of the equation, Josephson Junctions can be powerful computational tools for specific circumstances.

We wanted to make use of some of this modeling power that the junctions had, so our research was focused mainly on two projects, neuron modeling and looking for fluxon tunneling. We had an arrangement of Josephson junctions that has been seen to pulse in a similar fashion to neurons when current is applied to the entire system. What we were hoping to accomplish was to tie two of these fake neurons together to see if they can communicate with each other in a biologically realistic way. Namely can we get one neuron to stimulate the other under certain conditions, and can we get it to suppress the other neuron under different conditions? This would imitate the two interaction types seen in actual biological neurons, and would be a big step closer to having a biologically realistic way to simulate complex neuron interactions.

The other project was looking for signs of trapped magnetic flux caught in between junction arranged in a circular ladder. Since superconductors have no resistance to the flow of electricity, any magnetic fields passing through the junctions as they cool can induce current that are “stuck” in the loops until another current opposes them. This addition of current causes a “twist” in the phase of the junctions that have the current trapped between them. We wanted to first be able to observe these pockets of trapped flux (called fluxons) and to see if we could measure them jumping between cells in the ladder array as we slowly heated the junctions.


Faculty Mentor: Kenneth Segall  Department: Physics and Astronomy

Title of Project: Using a damped pendulum to solve for non-linear differential equation

Project Summary:

In solving differential equations, we are likely to encounter some situations when we have to turn to computer programs to solve for equations that cannot be solved by geometrical methods on a sheet of paper. Here, the motion of a damped pendulum, which can be written in the form:

\[ m\ddot{\theta} + b\dot{\theta} + mgL\sin\theta = \tau \]

Dealing with a second order non-linear differential equation, we want to build up a mechanical demo to present the motion based on its properties in physics in order to solve for the equation, and extend it further to an analogy of Josephson junction, a superconducting material which follows the same equation as its law of motion.

Based on the theory, there is a \( 4/\pi \) coefficient between the retrapping torque, which is correlated to the driving voltage when the whole system turns from rotation to static state, and the damping, which is caused by the extra mass attached on the bottom of the spinning disk. The correctness of the coefficient is the thing we want to prove by using the demo.

The whole operating system is constructed by several parts: two spinning magnets attached to an aluminum bar, a disk with a mass attached, a frequency detector, a pair of damping magnets and a wave scanner. Each of them is a figure in below:

![Spinning magnets, photo detector, damping magnets, wave scanner](image)

Spinning magnets cause eddy current on the disk and make the disk to spin. A series of spinning speed, which is displayed as the wave pattern on the wave scanner, with a certain driving torque and a combination of damping mass and damping torque is recorded in a table. We also record the switching voltage, which is the driving torque when the disk starts to spin, and the retrapping voltage, which is the driving torque when the disk rests from rotation. After some data analysis, we find the slope of each damping mass and damping torque combination versus the driving torque. We normalized both the retrapping torque and the slope, and by plotting the slope versus the retrapping torque, we end up finding that there is a linear correlation between the damping torque and the retrapping torque, whose coefficient is 1.29, which is only 1.3% off from the exact value of \( 4/\pi \).

Some further studies are still going on, one is to replace the magnets we have right now by two stronger magnets that are able to cause the pendulum to be over-damped in order to examine the case when the pendulum is over-damped, and the other is to add a magnetic detector on the side of the spinning magnets to measure their spinning speed in order to eliminate the error that could have been caused by the discontinuous correlation between the driving power and the spinning speed of the disk.

Title of Project: A Training Method of Improving Mandarin Speakers’ Production of Japanese Stop Voicing Contrasts

Project Summary:

As more and more students are learning Japanese, the problem of perceiving and producing stop voicing contrasts inaccurately is reported as an important issue by many Mandarin speakers. The main reason is that Japanese and Mandarin have different categories of stops: Japanese is divided into voiced ([b, d, g]) and voiceless ([p, t, k]) stops, while Mandarin is considered to have voiceless unaspirated [p, t, k] and voiceless aspirated [p’, t’, k’]. One significant measurement for stops production is voice onset time (VOT), which is referred as the time interval between the onset of voicing and articulatory release of stop. Negative VOT value means voice onset occurring before stop release, the burst release following the vocal fold vibration; positive VOT value means voice onset occurring after stop release, the vocal fold vibration following the burst release. In 1996, Fukuoka points out that Mandarin speakers produce Japanese voiced stops with positive VOT values when the values should be negative. Also, Mandarin speakers’ the frequency of the sounds tends to be higher. Therefore, Mandarin speakers exhibit a systematic and inherent difficulty during the acquisition of Japanese voicing contrasts. The cause of different Japanese and Mandarin VOT values can be explained by various second language acquisition theories, including speech learning model that is concerned with the age-related ultimate attainment of L2 pronunciation. Other second language acquisition theories (e.g. interlanguage and markedness differential hypothesis) are discussed because they attempt to predict generalized learning patterns, which provide the information about mechanisms behind language learning and helps learners to achieve more native-like perception and production. Also, some training methods, such as VT method, which uses body movement to tense up or relax body, and visual feedback, regarding this issue are examined in this paper.

In this study, an improved VT method is designed and its efficiency will be explored. Ten qualified Mandarin participants will be randomly selected at Colgate University and go through either control (i.e. traditional listen-and-repeat training) or experiment group. During the training, the experiment group will be instructed to perform body movement while reading a Japanese word list that is designed to raise or drop the tension, which is considered as the key to improve the pronunciation and achieve native-like production. All participants will be asked to do a pre- and post-test on Japanese stop voicing contrasts and their VOT values will be measured. Also, three faculties who are native Japanese speakers will record their production as models to analyze the effect of training. It is predicted that both groups have improvements and experiment group will have significantly greater improvement than control group. The implications of the results for language teaching and for future research will be discussed.

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: 189

Distribution of Students by Concentration (students with double majors are included twice)

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Distribution of Students by Faculty Division and Department:
(Number is greater than total number of participating students due to jointly supervised projects)

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Total Number of Participating Faculty: 79

Distribution of Faculty by Division and Department:

Arts and Humanities                   11
   Art and Art History                  4
   Classics                             1
   East Asian Languages and Literatures 3
   English                              1
   Religion                             2

Natural Sciences and Mathematics      43
   Biology                             11
   Chemistry                           8
   Computer Science                    3
   Geology                             8
   Mathematics                         1
   Neuroscience                        2
   Physics and Astronomy               7
   Physics and Astronomy; Pre-Engineering 1
   Psychology                          2

Social Sciences                       20
   Anthropology                        3
   Economics                           3
   Educational Studies                 2
   Geography                           4
   History                             2
   Political Science                   5
   Sociology                           1

University Studies                   7
   Africana and Latin American Studies 1
   Asian Studies                       2
   Environmental Studies               1
   Peace and Conflict Studies          2
   Writing and Rhetoric                1

Other                                 8
   Lampert Institute for Civic and Global Affairs 7
   Upstate Institute                   1
## Distribution of Faculty by Funding Source

(Faculty with more than one funding source are counted multiple times)

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# Index

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