
# 2025 Norwich Student Research Showcase

## Poster Session Abstracts

Undergraduate Research Program

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*Building Resilience: Social and Environmental Justice in the Built Environment*

**Ayla Browne, Andrea Brucato, Theresa Esabunefe, Jamie Fenhoff, Gavin Green, Blake Kierstead, Brogan McCormick, Nadalia McLeary, Oliver Meyo, Emma Pelletier, Brooke Premont, Devon Thibodeau, and Stephanie Unuane (Mentor: Wendy Cox)**

Architects depend on boundaries. In this architecture studio our prompt is how to re-imagine what a boundary is and could be. Can boundaries be a welcoming experience? Could a Border include housing, education, medical help and a place of bringing persons on both sides together? These are some of the questions the students answered with their projects in all three areas of knowledge, emotion and action. Our site was the highly political southern border between the US and Mexico. This studio is inspired by a beautiful activist project by the Museum of US in San Diego, California and the Friends of the Friendship Park. On the southern face of the border wall were amazing murals scheduled to be demolished in 2023 to build a taller wall. These stakeholders including photographer Maria Theresa Fernandez heroically saved the murals. “When Maria Theresa Fernandez gazed at the barrier separating San Diego – she saw more than a wall. Through her lens, it was a living breathing creature.” (KPPS Activists and Museum of US come together to save historic border wall murals, Gustavo Solis 3 21 24.) The murals act as bulletin boards for the community, hope, joy imagined on the other side of the wall and artists documenting the plight of migrants. Friends of the Friendship Park and other stakeholders saved 20 sections of the former wall. The caretakers are now considering how to integrate these historic pieces within the three communities of Mexico, US and the indigenous Kumeyaay Nation. These murals were integrated into their designs and act as points of inspiration.

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*Support for Transgender Girls/Boys in K-12 Sports*

**Dennis Dzubay and Zachary Cooney (Mentor: Jason Jagemann)**

What is the extent to which partisanship has a causal effect on support for transgender policies? Drawing on data from the 2024 American National Election Survey Pilot Study, this research examines the relationship between support for transgender policies and political party associations. The results show that there is a significant relationship between the dependent variables and the independent variable, which permits the rejection of all our null hypotheses. Those who identified as some level of Republican were more opposed to transgender policies than Democrats, while those who identified as some level of Democrat were more supportive of transgender policies, which positively corroborates our hypothesized split along party lines. The conclusions align with previous research, revealing the distinct divide between the political parties that expresses itself in polarized opinions on transgender policies and that warmer sentiments towards transgender people beget support for their rights but also indicate more vigorous opposition from Republicans compared to support from Democrats for transgender rights.

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*Operation Formosa - U.S., China, and Brazil Military Exercise*

**Benjamin M. Fairbank & Eric Barbosa Semedo (Mentor: Sergio Diaz-Luna)**

Our project examines the implications of U.S. and Chinese military forces training together in Brazil, analyzing the benefits and drawbacks of such cooperation. We explore how joint training could enhance disaster response, improve military diplomacy, and foster mutual understanding. However, we also address potential risks, including security concerns, geopolitical tensions, and the possibility of strategic competition influencing the training environment. By assessing historical precedents and current global dynamics, our research provides a balanced perspective on whether such collaboration can strengthen international stability or exacerbate existing rivalries in an increasingly multipolar world.

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-4-

*Angela Merkel: A Legacy Of Leadership*

**Emily Gates (Mentor: Marina Brajnikova-Aronson)**

This project's goal was to examine Angela Merkel's Leadership through the lens of psychological theories explored in the Psychology of Leadership course at Norwich University. As Germany's first female Chancellor, Merkel demonstrated a leadership style defined by pragmatism, emotional stability, and strategic foresight. Her approach aligns closely with the Big Five personality traits model, particularly in her high levels of agreeableness and conscientiousness, which enabled her to navigate crises such as the 2008 financial crisis and the 2015 refugee crisis. Additionally, Merkel exemplifies Katz's Three Skills Approach, with her strong human skills in diplomacy, technical skills rooted in her scientific background, and conceptual skills in long-term policymaking. By analyzing Merkel's leadership using these frameworks, this project highlights how her qualities contributed to Germany's stability and global influence. The study reinforces the importance of applying psychological leadership theories to real world figures, demonstrating how Merkel's methods offer valuable lessons for future leaders.

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*Relative Issue Importance and Partisan Models*

***Hong Kun-Yi and Gregory DeMeyer (Mentor: Jason Jagemann)***

The United States is experiencing its deepest political divide since the Civil War, with two dominant parties viewing each other as existential threats. This project argues that issue publics—groups intensely focused on specific political issues—are a key driver of this polarization. Using ANES Pilot Survey data, we demonstrate their outsized influence in shaping political discourse and decision-making. Factionalism has always been a natural part of human society, as recognized by political theorists throughout history.

However, modern technological, social, and global changes have intensified divisions, leading to deadlocks within liberal democracies, particularly in the U.S. While similar trends exist in other developed nations, this study focuses on the unique structure of the American political system—a Presidential Republic with a first-past-the-post electoral process that entrenches two dominant parties. Although these parties have coexisted in competition for nearly two centuries, recent shifts in their interactions raise concerns about the stability of American democracy. By identifying issue publics' role in polarization, citizens may find ways to mitigate their influence and restore a more functional political system.

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*Comparing Bacterial Communities in Echinostome Infected Snails vs. Not Infected Snails*

**Autumn Lewis (Mentor: Allison Neal)**

A genome includes all DNA that is found in an organism. A metagenome is a collection of genomes from multiple organisms that inhabit the same place (VBRN). Studying metagenomes will provide information on the community's makeup, structure, and functions in a specific environment. A study done by the Freshwater Mollusk Biology Society tested gut microbes in two snail species to better understand their diversity and functions. They were interested in whether differences in the bacterial community inside the snails existed, and if those differences corresponded to differences in the community's functions. There were no significant differences found in their study. We will be testing the microbiome of snails as well. Instead, we will be testing how one specific type of parasite can alter that microbiome. We aim to find out if there a difference in species diversity and composition in the bacterial communities of echinstome infected snails vs not infected snails. We collected around 50 viviparid snails and sediment samples from North Montpelier Pond on Sept 25, 2024, at around 3PM. We tested these snails for infection by looking for cercarial shedding and performing a dissection on the snails. We chose to use 4 infected and 4 non-infected snails and extract their DNA. We ran a 16S PCR, a few PCR modification steps, and electrophoresis. We sequenced the DNA using a MinION Sequencer. We performed data processing using VACC following a procedure by Emily Curd with a quality check, filtering, and classifying step. We did all data processing in R following scripts from Emily Curd as well. We used three measures to compare our bacterial communities including differential abundance, alpha diversity, and beta diversity. We found there to be a significant difference in differential abundance in gonad samples between infected vs. non-infected snails, but not differences in alpha or beta diversities in these samples. There was no significant difference in bacterial communities seem by the data in all three measures for the pre-dissection control samples. Therefore, bacterial communities between echinsotome infected snails vs not infected snails were not found to be significantly different. The alpha diversity in these bacterial communities was not different, and neither was the beta diversity. The number and types of species do not appear to be different between infected and not infected snails, regardless of what sample, gonad tissue or the predissection control samples.

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*Explaining Hubble Tension using an extended 'Dark Goo' model for dark energy*

**Amrutaa Vibho (Mentor: Jean-Sebastien Gagnon)**

Shear viscosity is (artificially) set to zero in the Dark Goo model, but it may have some interesting consequences. In particular, it may affect perturbations in the early universe, while leaving the dark energy-like behavior due to bulk viscosity in the late universe intact. This may help in explaining the so-called “Hubble tension” between early and late measurements of the Hubble parameter. The goal of the project is to study the effect of shear viscosity on cosmological perturbations and see if this has some observable effects (in the CMB in particular). We are attempting to modify the Dark Goo model to include shear viscosity using the Cosmic Linear Anisotropy Solving System (CLASS) and obtain CMB power spectra for this new model to explain the Hubble Tension.

# SENIOR CAPSTONE PROJECTS

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*How do first responders respond differently to non-natural and natural emergencies, and how do these differences in response negatively affect first responders’ mental health?*

**Luke Bachelder (Mentor: Presley McGarry)**

What practices exist in first responders' reactions to natural and non-natural emergencies, and how do these differences affect their mental health? How do first responders respond differently to non-natural and natural emergencies, and how do these differences in response negatively affect first responders’ mental health? I plan to use secondary data analysis to help me write my research paper. I will use other research papers and pick out the most common themes to help me. The results that I expect are how affective management helps first responders with their mental health. So, what I have found so far is that each town, city, state, or government responds to natural and non-natural emergencies in different ways, but they so far have at least one or two things in common with each other when it comes to mental health. I am hoping that with my findings and this research paper, I can help positively influence change for the better in some towns through training that incorporates mental health.

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*Nutrient Levels and Prey Density: Drivers of Carnivory in Aquatic Utricularia*

**Shannon Driscoll (Mentor: Lindsey Pett)**

Aquatic ecosystems in the state of Vermont are being inundated with nutrient runoff, leading to an excess and imbalance of Nitrogen and Phosphorus. Carnivorous aquatic macrophytes are commonly found in nutrient poor waters throughout Vermont. The response of carnivorous aquatic macrophytes to nutrient additions remains unknown and understudied. In this research we investigated the influence of environmental nutrient concentrations and prey dynamics on Utricularia vulgaris (Common Bladderwort), in lakes/ponds across the state of Vermont over varying N and P concentrations.

Our study examined the effect of lake nutrient concentration and prey density on U. vulgaris plant tissue nutrient content and morphological attributes associated with carnivory, such as bladder trap size and count. Our findings revealed a significant negative relationship between historical nitrogen levels and bladder count per leaf. We also found a significant negative relationship between historical phosphorus levels and bladder size. No relationship between water nutrient concentration and plant tissue nutrient concentration was found. But Seasonality had a significant negative relationship both in bladder count and size. Zooplankton prey density did not significantly expressions of carnivory. This works provides preliminary evidence that Vermont's enriched waters may be altering the morphology of a common carnivorous macrophyte.

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*Seasonal Changes in the Plankton of Twin Ponds*

**Xanthus Elliott (Mentor: Laurie Grigg)**

The zooplankton genus Daphnia is an important biological indicator of water quality and ecological health. Daphnia thrive in oligotrophic and mesotrophic waters. A decline in Daphnia has been observed in the last ~3,000 years in Twin Ponds located in Brookfield, VT. In order to understand plankton demographic trends, we collected water and plankton samples once per month from August to October of 2024. Zooplankton and phytoplankton specimens recovered were identified and counted for each month. Daphnia consisted of less than 10% of the total relative abundance of zooplankton specimens recovered. The most prominent taxonomic group of zooplankton in every month were Rotifers, which represented over 70% of the total relative abundance. In August, a Dinobyrne bloom was observed that represented over 40% of the relative abundance of phytoplankton that month and was likely the cause of the increased dissolved oxygen observed at that time. In the following months, the most prominent phytoplankton taxonomic group was Cyanobacteria representing 60-80% relative abundance. From August to September, surface water temperatures remained constant, which created favorable growth conditions for Cyanobacteria and led to increased abundance of Rotifers relative to other zooplankton. These demographics suggest that zooplankton populations are impacted by phytoplankton taxonomic group abundance.

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*Mechanics of the Dog River Fault Zone*

**Cole Funk (Mentor: Olivia Thurston)**

The Dog River Fault Zone (DRFZ) in Northfield, Vermont has been an area of active research for many decades due to the complex multi-phase deformation that the fault experienced during the Taconic, Acadian, and Alleghenian orogenies. Despite concerted effort by Westerman (1985) to properly identify the DRFZ as a shear zone, the definitive direction and timing of motion along the fault has remained widely unstudied. To address this gap in knowledge, strike and dip measurements and plunge and trend measurements were taken at three field sites across the three main formations in the DRFZ, the Cram Hill Formation, Shaw Mountain Formation, and Northfield Formation.

Samples were also taken from the Shaw Mountain Formation as it showed the highest degree of shear deformation, and these samples were made into thin sections and analyzed to determine the orientation and amount of deformation of the shear indicators. Both the field and lab measurements showed that the orientation of the movements in the DRFZ had a north-northeastern trend. These findings indicate that the DRFZ is a strike-slip fault with a north-south orientation and a reverse thrust oblique movement.

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*The Effect of Social Media on Adolescents Mental Health*

**Tulga Gankhuyag (Mentor: Presley McGarry)**

My goal is to present my research that was conducted by finding multiple sources to back up my ideas and findings on the effect of social media and mental health for adolescents, specially as they growing up and how it affects their motivations.

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*Breaking Barriers: Understanding Gender Differences in Employment Challenges for Parolees During Workforce Reintegration*

**Taylor Girouard (Mentor: Presley McGarry)**

Finding a job after being released from prison can be difficult, and these challenges can be different for men and women. Employment plays a big role in helping parolees reintegrate into society and stay out of prison, but female parolees often face extra obstacles compared to their male counterparts. This research aims to answer the question: How do employment barriers differ for female parolees compared to male parolees during reintegration into the workforce?

This study uses a mix of research methods, including reviewing existing studies, and analyzing job placement programs. The research focuses on understanding the different struggles male and female parolees face when trying to find jobs after their release.

Early results suggest that female parolees have more difficulties than males, including balancing childcare, dealing with mental health issues, and facing stronger societal stigma (Spjeldnes & Goodkind, 2009). Men, on the other hand, tend to have more access to job training programs and employment in labor-based fields. These differences suggest that support programs need to be adjusted to better meet the needs of female parolees.

The results of this study highlight the need for policies that provide better job training and support specifically for women, such as access to childcare and opportunities in fields where they are more likely to succeed. Addressing these issues could help more parolees successfully reintegrate and reduce the likelihood of returning to prison.

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*Determining the feasibility of BSTEM To Create a Hazard Map of landslides, Honey Brook Valley, East Barre, Vermont*

**John Hall (Mentor: George Springston)**

Landslides pose a significant hazard in Barre Town, Vermont, particularly in the Honey Brook Valley, where they threaten homes, roads, and future development. This study evaluates the feasibility of using the Bank Stability and Toe Erosion Model (BSTEM) to assess slope stability and generate a hazard map. BSTEM, typically used for smaller streambanks, was tested on slopes up to 140 feet high. Fieldwork at six landslide sites included geotechnical data collection and slope analysis. Four sites (LS2, LS3, LS5, and LS6) were analyzed using BSTEM, while two (LS1 and LS4) were too complex due to irregular stratigraphy. Results showed BSTEM effectively modeled slope stability at select locations, with Factor of Safety (FoS) values indicating instability: LS2 = 0.31, LS3 = 0.15, LS5 = 0.32, and LS6 = 0.47. A FoS below 1.0 signals instability and likely failure, while values above 1.0 suggest stability. The low FoS values highlight a high risk of slope failure, underscoring the need for mitigation. However, BSTEM's limitations with complex, non-planar stratigraphy suggest alternative or modified approaches may be necessary for a comprehensive hazard assessment.

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*The Correlation between Flooding and Human Reconstruction in Great Brook and the Winooski River*

**Ryan Hocker (Mentor: John Gartner)**

Flooding has become an increasing issue in the Northeast USA, with major events occurring in Vermont in 2011, 2023, and 2024. This study investigates the effects of flooding and subsequent human interventions on river stability and sediment transport in central Vermont's Great Brook, and Winooski River, using the nearby Bull Run and Dog River as a control site. Specifically, it compares areas with minimal human disturbance to those heavily altered by post-flood management activities, such as large woody debris removal and sediment manipulation. By measuring sediment size, channel stability, and the Shields parameter, the study aims to assess the impacts of human interventions on river dynamics. Results showed that disturbed sites had significantly smaller sediment sizes (D84: 12.3mm to 47.79mm) compared to undisturbed sites (D84: 56.95mm to 185mm), but the Shields parameter, an indicator of sediment transport stability, did not align with the hypothesis that human-altered areas would be less stable. Field observations of sediment disruption and the removal of large woody debris suggest that human activities may reduce the river's ability to resist erosion during future flood events. These findings highlight the complex relationship between floodplain management and long-term river stability and provide insights for future flood management strategies.

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*Beyond the Bells: The Influence of After School Programs on Juvenile Offenders*

**Rebecca Karis (Mentor: Presley McGarry)**

Access to after-school programs (ASP) plays a crucial role in youth development, providing structured activities that deter juvenile delinquency. Research suggests that engaging environments outside school hours lower crime rates among minors by offering supervision, skill-building, and positive peer interactions. This study examines the relationship between ASP availability and juvenile offender rates in Seattle and San Francisco. Using secondary data from the San Francisco Juvenile Probation Department, Washington's Data and Research on Juvenile Justice, and public records on ASP accessibility, the research analyzes whether increased access to these programs correlates with reduced youth crime. Statistical comparisons between the two cities will help determine if greater ASP accessibility is linked to lower juvenile offender rates. The anticipated findings suggest that the city with more accessible ASP will exhibit lower juvenile crime rates, reinforcing the argument that structured, supervised environments impact youth behavior and reduce delinquency, Research indicates that children without early intervention are six times more likely to face incarceration (Stephens, 2021), perpetuating intergenerational cycles of incarceration. Investing in preventive measures like ASP can break this cycle and reduce long-term societal costs associated with youth incarceration. Without such support, communities risk bearing the financial and social burden of increased incarceration rates in adulthood, reinforcing a preventable issue.

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*What Pests and Pathogens Were Found in Norwich University Trees and How Tree Characteristics Effect the Unique Taxa*

**Trevor Lancto (Mentor: Lindsey Pett)**

Pests and pathogens have been a major cause of tree mortality in urban environments leading to environmental and economic impacts. The purpose of this study was to determine what pests and pathogens were present on Norwich University campus trees. Trees on the main campus of Norwich University were identified and surveyed to gather morphological measurements and assess the presence of invertebrate pests and pathogens. It was found that total species richness both of commensalism species and pests/pathogens increased with tree size diameter at breast height (DBH) and overall tree height. The observed correlation between tree size and species richness is likely attributed to an increase in habitat size. It was also observed that insects comprised over 75% of all found pests and pathogens of Norwich University trees. Specifically, Camponotus sp. (Carpenter ants) were the highest abundance of all pests. The high abundance of Camponotus ants can be attributed to them being generalists and inhabiting any species of tree. Conducting research on pests and pathogens in trees is crucial for identifying potential threats to tree health and monitoring the spread of invasive species and disease.

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*Death Penalty in the modern day*

**Shadrick Lemons (Mentor: Presley McGarry)**

The goal of my project is to analyze the effects the death penalty has on the criminal justice system, and whether or not the death penalty is an effective deterrent against capital crimes based on pre-existing data.

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*Origin of Felsic Igneous Trapped in the Dog River Fault Zone, Central Vermont*

**John Lemos (Mentor: David Westerman)**

This study was conducted in the Northfield and Roxbury quadrangles within the Dog River valley, geologically situated in the Dog River Fault Zone (DRFZ) between Silurian-Devonian and Cambrian-Ordovician strata. Research focused on pale-colored rocks previously mapped as part of the Shaw Mountain Formation. Primary objectives were to determine whether mylonitized rocks in this area are of sedimentary or igneous origin and to assess if they should be included in the Shaw Mountain Formation. The investigation revealed that some felsic rocks mapped as Shaw are strongly sheared, rich in plagioclase and lack typical sedimentary heavy minerals. Minor zircons in these rocks are distinctly rounded. Geochemical analysis distinguished these felsic rocks from mylonitized Shaw sedimentary rocks. Major and minor elements of the felsic rocks were poor in FeOtot, MgO and LOI and richer in Na2O; trace elements were lower in Eu, La, Nb, Nd, Rb, Th than the other samples, suggesting an igneous origin. These analyses also reveal a high Na:K ratio characteristic of trondhjemites, but the only trondhjemites in the vicinity are in the nearby Northfield Intrusive Complex. Possibly the DRFZ captured fragments of this complex during post-Acadian tectonic activity, explaining the presence of these distinctive rocks.

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*Emerald Justice: An analysis of the impact of Irish Americans on the Massachusetts Justice System*

**Declan McClellan (Mentor: Presley McGarry)**

*No abstract provided*

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*An Investigation of Structural and Mechanical Tree Defects at Norwich University*

**Tyler Phipps (Mentor: Richard Dunn, Lindsey Pett)**

This study is aimed at analyzing tree health, injury prevention, and injury management on Norwich University campus trees. 53 trees were surveyed for a range of morphological attributes, like DBH and canopy cover, structural defects, such as bole wounds and cracks, and finally mechanical damages, such as cut roots. An analysis of injuries was completed using ImageJ.

Program R was used to compare factors such as DBH, age, injury location, injury type, and surface area of defects using ANOVA tests, Pearson's Correlation Coefficient, and linear regression models. The 7 Acer platanoides observed had the highest defect rates amongst all tree species present. The 5 Pyrus calleryana had an average of 10.2 defects per tree, the lowest average of all species sampled. The most common defect was bark inclusions. The most common type of defect were trunk structural defects. Acer platanoides is the tree species with great concern for injury rates, and the most common defect we need to analyze to protect campus trees are trunk structural defects. To carry out further research, more trees on campus would have to be surveyed at different locations. Studying trees near barracks and dormitories could tell a different story of issues being faced.

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*What are the Leading Psychological Factors of Child Exploitation in Children and How do Vermont and Federal Courts Prosecute?*

**Isabella Ross (Mentor: Presley McGarry)**

Child exploitation has been an ongoing issue in society for decades; however, with the increased use of technology, child exploitation has become easier to execute. To understand how to combat this crime, researchers and investigators must understand the psychological factors in children leading up to the exploitation and how both Vermont and federal law enforcement prosecute.
Interviews with victims and offenders will be reviewed, and behavior patterns will be analyzed. These interviews will come from the Internet Crimes Against Children (ICAC) task force in Vermont and Homeland Security Investigations (HSI). Based on these interviews, patterns of grooming and luring are predicted to be found by the offender to the victim. From the victim's side, there might be a variety of behaviors that increase the offender's willingness to seek out and victimize a child.
The overall goal is to apply these findings to law enforcement officers' training. Helping officers understand the leading factors of child exploitation will allow for earlier interception in the child exploitation process, and it can help protect children further.

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*Child Predation in Multiple forms of Social Media*

**Tyrian Saeturn (Mentor: Presley McGarry )**

My projects goal is to spread information on different types of social media platforms, that parents aren't aware of, that have many ways child predators can get ahold of their child, some they wouldn't even think of at all. I use statiscal data from other sources that have tracked child predation on multiple platforms and the overall outcome of this project is to spread awareness about online safety and monitoring for children.

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*Paleoproductivity and erosional indicators of two Vermont Lake Pairs*

**Olivia Smith (Mentor: Laurie Grigg)**

The sediment cores and water quality of two lake pairs in Vermont were sampled and analyzed to assess paleoproductivity changes over time since the settlement of Europeans, focusing on the rate of increase in productivity between mesotrophic and oligotrophic lakes. Top-down core analyses of paleolimnological and lithological data show increases in erosion over time in all four cores but are not indicative of increased productivity in deep oligotrophic lakes compared to their shallower counterparts of similar latitude. Paleoproductivity was measured by percentage of organics lost on ignition, macrofossil concentrations, and biogenic silica. Lithological data was measured with density, magnetic susceptibility, and geochemical analysis. The proposed explanation for decreased productivity in deep lakes is increased thermal stratification periods that reduce internal nutrient loading and decrease photic zone depth, leading to decreased photosynthesis, with future implications of decreasing dissolved oxygen (DO) content in the hypolimnion. Increases in concentration and high relative abundance of a generalist species of zooplankton, Bosmina, in shallow ponds indicate poorer water quality and less favorable conditions for sensitive species. The results show opposite yet detrimental effects on meso- and oligotrophic lakes in Vermont.

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*Manganese occurrence in home wells of central Vermont: A Local or Regional Source*

**James Smith (Mentor: Richard Dunn)**

A private residence with a 500 ft water well in Newbury, VT, reported black staining in house plumbing, and particulates in tap water during well overuse or drought conditions. These phenomena are typical of groundwater manganese (Mn) derived from bedrock leaching. Water samples were collected for ICAP mass spectrometer elemental analysis at the residence, from nearby home wells, and from local streams flowing across bedrock lithologies. Due to drought conditions, stream water provided an approximation of groundwater geochemical conditions. Waters were also analyzed by YSI for pH, dissolved oxygen, and redox potential.Bedrock and soil samples were similarly geochemically analyzed, all in an attempt to locate a local or regional Mn source. All water samples contained levels of Mn below EPA standards. Minor variations in Mn concentration appear to correlate with zones of mafic meta-dike bodies of the Albee Formation, which underlies the site of concern. The home's low Mn values and the influence of bedrock on groundwater Mn concentration suggests that Mn is regionally sourced.. Low oxygen content within the home's water system may be the reason for the precipitation of Mn in the home, but the relationship to low water levels remains unclear.

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*Mongolian government agencies efficiency in resolving petitions and complaints*

**Jambaatseren Sukhbaatar (Mentor: Presley McGarry)**

This research analyzes the implementation of the right of citizens to file petitions and complaints with government institutions and officials in Mongolia. The study explores the legal framework governing this right, its practical implementation, and the challenges citizens face when seeking resolution for the grievances. The study employs both qualitative and quantitative analysis research methods, including analyzing legal frameworks, surveys and interviews.

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*Comparison of Water Infiltration Rates of Alluvial and Glacio-Lacustrine Sediments in Central Vermont*

**Theodore Tonna (Mentor: Richard Dunn)**

This study compared water infiltration rates in two common materials of central Vermont: deposits from a modern floodplain and a Pleistocene glacial lake. Water infiltration rates depend on grain size, grain sorting, and pore space availability and interconnectedness, or permeability. It was assumed that glacial lake deposits, normally characterized by well-sorted sands, would have a higher infiltration rate than floodplain deposits, which typically feature fining-upward grain sizes culminating in sandy clayey silt. Water infiltration tests were conducted using a single-ring infiltrometer and constant hydraulic head. Sediment samples were taken for moisture content determination and grain size analysis using sieves and the settling tube procedure. Floodplain deposits are generally poorly-sorted, very fine silty sand, while lake bottom deposits were poorly-sorted, very fine sandy silt.

Infiltration rates in the floodplain decreased from 800 mL/min to 130mL/min once the top 60 cm of sediment were removed, revealing siltier, more poorly sorted sediment in the subsurface with reduced permeability. Comparatively, infiltration rates of the lake bottom were 270 mL/min, explained by a coarser silt fraction and better sorting and higher permeability. In summary, sorting as a function of the amount and size of silt is likely the limiting factor for infiltration in these sediments.

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*Modern warfare, international humanitarian law (IHL), and the impact of drones and autonomous weapon systems on legal and ethical frameworks*

**Wei-Cheng, Wang (Mentor: Presley McGarry)**

The rapid advancement of artificial intelligence and military technology has significantly transformed modern warfare. Among the most controversial developments are drones and autonomous weapon systems (AWS), which can operate with varying levels of human intervention. While these technologies offer strategic advantages, they also present critical legal and ethical challenges, particularly in the application of International Humanitarian Law (IHL).

IHL is designed to regulate armed conflicts by ensuring the protection of civilians and setting limits on the conduct of hostilities. However, the growing use of drones and AWS raises concerns about compliance with key legal principles, including distinction, proportionality, and accountability. The ability of these systems to make life-and-death decisions without direct human control complicates traditional frameworks of warfare and poses serious questions regarding responsibility for potential violations.

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*Mental Health in Policing*

**Sophie Zemianek (Mentor: Presey McGarry)**

My goal is to familiarize and make others aware of the everyday struggles of mental health an officer will face and deal with within their professions. Being and officer is a very demanding job and the lack of awareness towards officers mental health is consistently unnoticed and my goal is to help end the stigma as well as create an understanding as to how it can affect an officer.

## RESEARCH CENTERS & HONORS PROGRAM

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*AQUA-CLIME*

**Sulley Adinan, Agnes Antwi, and Enock Nyame (Mentor: Tara Kulkarni)**

Water security is increasingly threatened by climate change, disproportionately impacting Native American and flood-prone agricultural communities. The Advancing QUAlity and CLimate-ResIlient Water Management with Community Partnerships and Enhanced Sensor Network (AQUA-CLIME) project integrates Indigenous knowledge with advanced sensor technologies to enhance water monitoring, data sovereignty, and climate adaptation strategies.
As part of the workforce development team (Area 3), our focus is on building a STEM pipeline by engaging K -12 students, undergraduate and graduate researchers, and frontline communities. Through education and outreach, we aim to improve public understanding of climate-resilient water management.

We have developed prototype water monitoring models, which will be showcased in an upcoming STEM program to communicate research findings. Expected outcomes include improved sensor networks, scalable decision-support tools, and the establishment of the first MS program for tribal students at Pine Ridge Reservation. AQUA-CLIME fosters sustainable, community-driven solutions for equitable water management in climate-vulnerable regions.

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*Evolution of Cold War doctrine and its influences*

**Jacob Barr (Mentor: Rowland Brucken)**

This project aims to identify and describe the evolution of NATO and Warsaw Pact military doctrine and the factors that influenced their evolution. The research project focuses on the Soviet and Warsaw Pact Deep battle doctrine and contrasts it to American and NATO Air air-land battle doctrine and its effective employment in history.

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*Exploration and Expansion of Mirror Labelings*

**Jonathan Calzadillas (Mentor: Daniel McQuillan)**

Professor McQuillan and I worked on a project to improve on work done by researcher Ian Gray to label mirror labelings of C_2k for k≥2, of which only provided a construction for C_(8k+2).We improve on this result by providing all other cases of C_2k for k≥2, that is C_(8k+6) and C_4k for k≥1.

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*Supporting Cyber Defense Practicum (IA456) using Virtual Systems*

**Jo Cordova (Mentor: Huw Read)**

Poster explaining the class, and how CyFER has supported the Cyber Capstone throughout the semester in designing the course.

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*Digital Communication Strategies of U.S. Foreign Policy Agencies: Analyzing Social Media Usage, Engagement, and Purpose*

**Sophia M. Righthouse (Mentor: Jason F. Jagemann)**

This study examines how U.S. government foreign policy-related agencies utilize social media, specifically the platform X (formerly Twitter), to convey information related to their mission statements. This research analyzes the communication styles of intelligence, military, and foreign agencies using tone, content type, and engagement metrics. This study illuminates the strategic diversity in digital communication among U.S. foreign policy-related agencies, underscoring social media's nuanced role in shaping public perception and trust in government. The implications of these findings highlight the importance of balanced, transparent communication as these platforms continue to influence both domestic and international views on U.S. foreign policy.

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*Supporting Virtual Systems Administration with Scripting Automation*

**David Rivera (Mentor: Huw O.L. Read)**

Poster taking about an independent project to improve scripting automation for CyFER virtual systems administration.

# RESEARCH ON EXTERNALLY FUNDED GRANTS

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*Potential Responses to the Threat of Information Warfare*

**Brett Carlson (Mentor: Mark Perry)**

This project will present a framework to identify measures the United States government could take to counter Information Warfare and to evaluate the impact of these measures in the areas of legality, civil liberties, political risks, and the likelihood they can be implemented and work effectively towards their intended goal. The group of measures that will be analyzed will fall under eight categories: education, kinetic warfare, information operations, cyber operations, economic warfare, foreign relations, domestic policy, and lastly the option to maintain the status quo and not pursue any changes to the United States' approach toward Information Warfare. Information was collected from relevant and reliable meta-analyses, case studies, and studies on each policy area. The outcome of this project is to inform United States policy making by creating a table ranking each response type and a justification for each ranking to give an idea of what should be given the most attention.

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*Evaluation of Types of Body Dissatisfaction at Norwich*

**Abby Chauvin (Mentor: Kylie Blodgett )**

This study examines body dissatisfaction in military college populations, focusing on body image concerns at Norwich University. This study uses the Drive for Muscularity Scale, Weight Concerns Scale, and Body Appreciation Scale (BAS-2) scores across different groups at Norwich University, analyzing by gender, military or civilian status, and varsity athlete, non-varsity athlete and non-athlete status. The Drive for Muscularity Scale shows significant differences between civilians and military personnel, with ROTC students scoring higher ($p = 0.0207$), indicating a stronger drive for muscularity. Males also scored higher than females on the same scale ($p = 0.0014$). On the Weight Concerns Scale, females scored higher than males ($p = 0.00099$), indicating greater concerns among females. The BAS-2 showed that males had higher body appreciation than females ($p = 1.06E-05$), and non-varsity athletes scored higher than non-athletes ($p = 0.0064$). Varsity athletes also showed a significant difference in body appreciation compared to non-varsity athletes ($p = 0.0231$). Males and ROTC students showed a stronger drive for muscularity, while females expressed greater weight concerns. Additionally, varsity athletes showed higher levels of body appreciation compared to non-athletes and non-varsity athletes.

*Cytotoxicity of Atmospheric material: exploring the impact of air particles on human health*

**Kingsford Frimpong (Mentor: Jeffrey R. Kirkland)**

This research aims to investigate the health impacts of particulate matter (PM) on human health by collecting and analyzing real atmospheric samples across multiple seasons in central Vermont. Air quality has a profound effect on public health, yet the exact mechanisms by which PM influences health outcomes remain inadequately understood. Approximately 36% of Americans live in areas exceeding the air quality standards set by the Environmental Protection Agency (EPA), leading to significant risks for cardiovascular and respiratory health, as well as exacerbation of pre-existing conditions such as asthma.

To address these concerns, this project proposes to build a comprehensive library of seasonal PM samples collected using a Hi-Vol PM10 sampler, strategically deployed on the roof of an academic building at Norwich University. This sampling site is uniquely positioned to capture a diverse array of PM influenced by local, regional, and anthropogenic sources, including residential wood burning, traffic emissions, and biogenic particles from surrounding forests. By focusing on seasonal variations, the research aims to elucidate how PM composition changes with weather patterns and environmental conditions, providing a more nuanced understanding of human exposure to these harmful particles.

The collected PM samples will be subjected to cytotoxicological analysis using snail cells (Biomphalaria glabrata), which have been shown to accurately represent inflammatory responses similar to those observed in human lung tissue. The cells will be exposed to slurries of PM samples, and the resulting stress responses will be quantified through lactate dehydrogenase (LDH) assays, which measure cellular damage and inflammation. This approach allows for direct connections between air quality and health effects, bypassing the complexities of initial chemical composition analysis while still harnessing the real-world variability of atmospheric samples.

By taking this innovative pathway, the research seeks to reveal critical correlations between seasonal variations in PM and associated health outcomes, ultimately informing more specific public health advisories. The anticipated results will not only enhance our understanding of the health impacts of PM but also contribute to the development of predictive models that link air quality with public health outcomes.

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The Role of Myc in Regulating Macrophage Mitochondrial Metabolism

Diego Ledesma (Mentor: Parker Woods and Gokhan Mutlu)

C-Myc and Hif1-a are transcription factors that regulate cellular metabolism in cells under normoxia and hypoxia. Under hypoxia, Hif1-a has regular glycolic metabolism in the cells, and when Hif1-a is knocked out in cells under hypoxia, we see an increase in mitochondria function. We thought C-Myc was the main cause of an increase in mitochondria function. After further analysis using western blot assays and qPCR tests, we concluded that C-Myc was not the cause of an increase in mitochondrial function. That C-Myc expression was decreased when Hif1-a was knocked out in cells.

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*Predicting Healthcare Costs Using Machine Learning: A Data-Driven Approach with Age, Sex, and Diagnoses*

**Sujan Parajuli (Mentor: Natalaie Cartwright)**

Healthcare costs can vary widely based on factors like a person's age, sex, and medical condition. In this study, we used machine learning to predict the total Patience based on these factors. Our data comes from the 2016 Nationwide Emergency Department Sample, provided by the Healthcare Cost and Utilization Project.

## UR PROGRAM APPRENTICESHIPS & FELLOWSHIPS

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*Exploring the Impact of Sleep Quality and Maladaptive Eating Habits on Stress Levels in College Students*

**Ashley Parker (Mentor: Kylie Blodgett)**

The goal of our study is to create a machine learning model that accurately predicts medical expenses based on patient data. Such a model can be used to understand which factors influence healthcare costs.

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*Exploring the Role of Bacteria in Snail Health and Trematode Infection*

**Keziah Akramah (Mentor: Allison Neal)**

Snails are common hosts for trematode parasites, which can significantly impact their health and survival. Recent studies have suggested that the microbiome of snails may play a role in their ability to resist or tolerate infections. The relationship between snails' bacterial communities and trematode infections is not fully understood. This research aims to explore whether bacteria from uninfected snails can influence the health or the survival of trematode infection snails.

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*Enhanced Stock Price Prediction: A Novel Approach Integrating LSTM and Mean Reversion*

**Shimron Alakkal (Mentor: Charles Snow)**

In the realm of financial automations and trade predictions, the quest for accurate and robust models for predicting asset prices has led us to the exploration of innovative hybrid models. With this research, I am trying to combine the strengths of Long Short-Term Memory (LSTM) networks, a powerful class of recurrent neural networks, Modern Portfolio Theory (MPT) and some other mathematical functions like mean reversion to be able to foresee the movement of price of an asset, extrapolate it for a future time period, and generate trade signals – primarily for equity prices. By combining the capabilities of deep learning and mathematical functions, I aim to develop a comprehensive framework for forecasting future prices of financial assets that could be used by asset management firms or individual retail investors alongside their existing set up.

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*Multi-species Algae Cultivation for Biofuel Production*

**Sam Cannon (Mentor: Simon Pearish)**

Fossil fuels contribute to climate change and are non-renewable. Biodiesel has been proposed as a renewable alternative to fossil fuels. First-generation biodiesel is produced from oilseed crops. Producing this form of biodiesel has shortcomings such as land use, energy consumption, and other negative externalities. A promising solution to this is biofuel produced from algae. Algae has higher yields of combustible oil than seed crops, it rapidly consumes CO2, it grows rapidly, and it has a smaller production footprint than other feedstocks. Currently, research in this area involves growing algae in monocultures, which must be protected from contamination and grown in carefully regulated environmental conditions. Multi-species cultures might provide a low-maintenance alternative to monocultures if they are resistant to invasion or adaptable to fluctuating environmental conditions. In this project, we test the hypothesis that multi-species algae cultures can produce oil at a rate that is comparable to that produced in monoculture. Oils from several unique multi-species algae cultures were extracted via enzyme assisted extraction methods and converted into biodiesel via a base-catalyzed trans-esterification reaction. We report extracted oil yields, composition of extracted oils as determined by GC-MS, and the characteristics of the converted biodiesel as determined by ASTM fuel standards testing.

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*Using a Modified Principal Component Analysis to Recover State Information From a Corrupted Dynamical System for Modelling*

**Anthy Khanal (Mentor: Sean Kramer)**

When modeling predator-prey populations in 2d space, as described by a system of two parabolic partial differential equations, state space information could get corrupted during transmission or collection.

This has been a problem in research; as usual, analysis is done via satellite images, which have a high probability of having significant errors in some regions. While that wouldn't be a problem for systems with minor sensitivity, errors could cause significant divergences from actual state behavior in diffusion population systems, which is the system under study. Principal Component Analysis (PCA) is a mathematical method used to realign high-dimensional data to a different dimensional axis by recognizing major principle components of the data. It is a method used in image and error detection, as images can be represented as points in spaces with very large dimensions. However, due to the sequential nature of dynamical system data, a modified PCA uses windowed time steps as data points to identify the principal components of a predator-prey system modeled using some initial state parameters. Then, the PCA was used to recover data that had been erased from a second model using different initial state parameters using PCA inpainting, and the recovered data was used to drive a system in equilibrium into matching the second system. This setup restored the driving system's behavior even when the corruption (noise and date erasure) affected 30% of the data used for transmission, indicating PCA can recognize and imprint the nonlinear nature of the dynamical system when extended to the time dimension.

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*The Impact of Body Positivity on Mental Health and Wellbeing in South Asian Communities*

**Grishma Nepal (Mentor: Bernard Maniscalco and Kevin Fleming)**

This research explores the interplay between body positivity, mental health, and cultural norms within South Asian communities. The study investigates how societal expectations, cultural preferences, and global beauty standards influence body image perceptions, particularly among South Asian women. Through a mixed-methods approach, including focus group discussions and a survey with 56 South Asian participants, the research uncovers the challenges posed by deeply ingrained cultural norms, such as a preference for lighter skin tones, and the impact of globalization on beauty ideals. The findings reveal that while body positivity is increasingly recognized, there is often confusion between body positivity and fat positivity, limiting the movement's broader acceptance. Participants expressed significant pressure to conform to traditional beauty standards, leading to body dissatisfaction, eating disorders, and mental health struggles. This research emphasizes the importance of culturally sensitive interventions to promote body positivity and mental well-being, fostering a more inclusive and supportive environment for South Asian communities. The study highlights the need for increased education, media literacy, and community-based initiatives to address the unique challenges faced by South Asians in navigating body image concerns within a globalized context.

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*One laptop per child: The Use of Technology in Early Education in Rwanda*

**David Nziza (Mentor: John Puleio)**

Rwanda's One Laptop Per Child program was started in the country with the goal of providing each child in primary school with their own laptop.

This research project allowed a study of some education programs in Rwanda that enable students to have an equal opportunity to learn and develop their digital literacy skills like any other student around the world. The purpose of the research was to interact with different stakeholders to understand how students benefit from the availability of this learning tool and to shed light on the importance of exposure of this technology in a child's life. The research methodology involved interviewing teachers who used this tool the most. The best way to learn about the impact of this program was to get different perspectives from different types of teachers who used these laptops in different ways. With authorization from the Rwanda Education board, these interviews were conducted in 4 different schools in the country, each school was in a different district from the 30 districts in Rwanda. The stakeholders involved in this program describe the students' improvement of digital literacy skills and the overall experience as life changing and instrumental in their educational journey. Additionally, they spoke about the impact it has had beyond the classroom.

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*The Prevalence of Ticks and Tick-Borne Disease at Different Elevations on Paine Mountain*

**Erika Park (Mentor: Allison Neal)**

The goal of this project was to start the foundation work around tick research here at Norwich University, as well as spreading awareness to students, faculty, staff and locals about ticks and tick borne disease.

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*The Mind in Chains: Psychological and Moral Perspectives on Humbert Humbert in Lolita*

**Andrii Shadrin (Mentor: Kyle Pivetti)**

The research investigates Vladimir Nabokov's Lolita, exploring the psychological, literary, and societal dimensions of the novel. It primarily examines the complex character of Humbert Humbert through Finkelhor’s Precondition Model, elucidating the psychological mechanisms that drive his predatory behavior. By applying close reading, intertextual analysis, and archival research, the study goes deep into Nabokov's stylistic choices, narrative techniques, and thematic intentions. The research also focuses on the profound psychological impact of Humbert's actions on Dolores Haze, highlighting issues of trauma, identity formation, and resilience. Through this multifaceted approach, the study not only offers a comprehensive analysis of the characters and themes within Lolita but also contributes to broader discussions on child sexual abuse, the psychology of obsession, and the ethical implications of literary representation.

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*Dreaming AI*

**Lakshya Shah (Mentor: Jean-Sebastien Gagnon)**

This research explores the concept of "Dreaming AI," where a neural network simulates the human brain's pruning process during sleep to enhance its learning efficiency. The hypothesis suggests that allowing a neural network to "dream" by feeding it abstract images and reducing the weight of less useful neurons could decrease the number of training iterations, improve accuracy, and enhance data generalization. This study involves developing Python code for a neural network capable of classifying handwritten digits and implementing the Hebb rule to adjust neuron weights during the dreaming process. Initial findings indicate potential benefits, though further research is required to confirm the hypothesis.

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*Dietary Behaviors Among Military and Civilian College Students*

**Molly Yacavoni (Mentor: Kylie Blodgett)**

Evidence suggests dietary behaviors in college students and military populations may not be strong enough to adequately support their needs. Exploring potential factors that could affect diet may help understand the needs of this population. Norwich University has both traditional college students and military trainees, providing an appropriate population to begin to address this gap. This study explores the dietary and behavioral patterns of Norwich University students, to explore factors that may predict diet quality. Participants were recruited at the beginning of the academic year to complete a survey measuring diet quality resilience, physical activity behaviors, sleep quality, and mental health. None of the physical or mental health variables were related to diet quality of participants (n=77). Diet quality differed by gender (p=0.028897046), with females (n=29) having a higher diet quality than males (n=45). There was no difference in diet quality by lifestyle (military vs. civilian, p= 0.3923385). These findings suggest that mental and physical health-related behaviors may not have an impact on diet quality, but cultural implications are important to consider. Future assessments should investigate the influence of gender on diet quality considering biological and sociocultural differences and how those may have a direct impact on overall diet quality.