BARD

Summer Research Institute

POSTER SESSION

FRIDAY, OCTOBER 21
4-6 P.M. RKC LOBBY

Water Chestnut and Salinity in the Hudson River

Nique Allen, Kylie Quinn & Gillian Randall
Advisor: Kathryn Anderson

Trapa natan, commonly called Caltrop or Water Chestnut, is an annual aquatic macrophyte native to North Africa, Asia, and Europe. *T. natan* was introduced to New York waterways in 1884 as a garden botanical and spread into the Mohawk River Valley before expanding into the Hudson River. *T. natan* is considered an aggressive invasive species because it grows in dense colonies that displace native species and negatively affect the recreational and commercial use of waterways. As a freshwater species, it had been thought that *T. natan* has low saline tolerance and would not be found in environments with high salinity. However, the Hudson river is a tidal estuary with freshwater flowing in from the north and saltwater flowing in from the south. This experiment questions whether *T. natan* from the high saline edge of its range will perform better than individuals collected from a fully freshwater location when exposed to water at higher saline concentrations. Plants were collected from two sites with different salinities in the Hudson River: Norrie Point State Park, and Iona Island at Bear Mountain State Park. Individual *T. natan's* were kept at 13 salinities (ranging from 0 to 12 ppt) for ten 10 days to understand the role salinity plays in the geographic range and distribution of this aquatic invasive. We monitored twelve different morphological variables as indicators of individual condition. While data analysis on survivorship and health is still pending, we did find that individuals

collected from our high saline site were different in terms of their developmental stage, as they had developed larger seeds and were further in their development. At this point it is unclear if genetic or environmental differences between the two sites explain the differences we observed. Continued research into the effects of salinity on *T. natan* would be important as multiple climate change factors (eg. rising sea levels, increased droughts, and lack of snow) impact salinity concentrations in the Hudson River, and thus may impact spread of this species.

Synthesis of Organometallic Compounds Using Dipyrromethene Boron Difluoride

Lilah Blaker & Mariam Morsy
Advisor: Craig Anderson

Dipyrromethene Boron Difluoride (BODIPY) is an organic fluorescent molecule which can be modified in many ways and reacted with transition metals to synthesize an array of organometallic compounds. We have synthesized and purified a BODIPY-derived ligand that has a pyridine moiety appendage that was used for bonding to platinum and ruthenium. We synthesized two compounds with this ligand and measured their luminescence.

Chemical Characterization of North and South Twin Lakes

Genesis Cabrera
Advisor: Emily White

Human activities contribute to the problem of lake eutrophication through the addition of excess nutrients (phosphorus and nitrogen) from fertilizers and leaking septic systems. These nutrients can cause algal blooms (some of which can be toxic) and generally poor water quality conditions that make lakes less suitable for recreational use. As a result, many lake communities are working to improve lake management practices to control eutrophication. The North and South Twin Lakes (Elizaville, Columbia County, New York) are showing early signs of eutrophication (i.e., surface algal blooms) but little water quality monitoring data is available. In order to characterize these lakes, a detailed chemical analysis was conducted on samples collected monthly from July to September 2022. Temperature, conductivity, pH, and dissolved oxygen were measured in the field and samples were tested for fecal indicator bacteria. The concentration of cations, anions, nutrients, carbon, and metals were determined in the laboratory. Anecdotally, less algal growth was observed this summer, likely due to the lack of rain. As previously reported, South Twin Lake was found to have higher conductivity than North Twin Lake from road salt, due to local topography. These results will be used to identify further monitoring needs and inform future studies addressing community concerns.

High Optical Power Set-up to Characterize Degradation of Coatings

Kace Colby & Luka Ingraham
Advisor: Antonios Kontos

The Laser Interferometer Gravitational Observatories detect gravitational waves, which are ripples in spacetime caused by massive astrophysical events. The detectors are large laser interferometers that measure these ripples by monitoring the distance between two mirrors placed 4 km apart. A significant challenge when designing and operating these detectors are isolated from sources of noise. The mirrors used in the detectors have reflective coatings that vibrate slightly due to thermal excitation, giving rise to thermal noise. Reducing the noise caused by these coatings is an ongoing area of investigation. Our experiment is designed to discover how defects may be created on mirrors by high power lasers such as those used at LIGO. Our setup places a test mirror in a ultra-high vacuum environment designed to simulate conditions used in LIGO detectors and uses an optical cavity to amplify a laser beam by a factor of 4000 in order to expose the test mirror to high power.

Reconstruction of 2D to 3D Structures in the Microscale

Anders Dollard & Nasif Hossain
Advisor: Chris LaFratta

Two-Photon Polymerization (TPP) enables the creation of 3-D structures with sub-micron resolution. It has been used in optics and bioengineering and has great potential to contribute to lab-on-a-chip applications; however, there has been a lack of standard ways to characterize structures made by TPP. This project proposes digitally rending structures in 3-D space and comparing that with its theoretical counterpart. The structures are imaged by Scanning Electron Microscopy (SEM) and reconstructed using a structure from motion Autodesk ReCap Pro. This software takes 2D images and reconstructs them in 3D space. The newly constructed image can then be compared to its theoretical counterpart with CloudCompare. Additionally, our ability to create arbitrarily detailed structures was limited by our path-making method, which relied on a hand-written Excel sheet of commands. We created arbitrarily detailed 3D structures through a 3D modelling software called Fusion360, enabling the production of arbitrary 3D microstructures.

Investigating Long-term Legacy Effects in *Geum canadense*

Mary Douglas
Advisor: Cathy Collins

Plants and soil microbes interact reciprocally, shaping both above- and below-ground communities through processes termed plant-soil feedbacks (PSFs). These interactions between plants and soil microbes span from mutualisms to parasitisms and have been posited as a mechanism for maintaining plant diversity. Each plant species influences soil microbial community composition, and the legacy of a plant species on soil microbes has been found to remain in the soil even after the plants are no longer present. Yet, previous research has found these legacy effects to be relatively short-lived – rarely longer than two years after plant removal. In this study, we focus on the perennial herb, *Geum canadense*. We aim to determine 1) whether *G. canadense* exhibits positive or negative intraspecific PSFs, 2) whether these PSFs create legacies in soil microbial communities, and 3) how long these legacies are detectable. To answer these questions, we used a long-term fragmentation study at the University of Kansas Field Station. We grew *G. canadense* plants in soils with different *G. canadense* histories, ranging from never present in the soil to continually present for differing lengths of time. We hypothesize both that *G. canadense* will experience negative PSFs and that these PSFs will have some legacy, decreasing in strength as time since last *G. canadense* occupation

increases. Our study makes use of a rich 40-year data set, providing the opportunity to investigate long-term PSF legacies, in contrast to previous work that has been limited to shorter time scales. Our investigation of the directionality and legacy strength of PSFs in *G. canadense* offers insight into the complex mechanisms that maintain plant community diversity across time scales that reflect patterns of changing community composition.

Synthesis and Characterization of Pt(IV) Complexes with Isocyanide and Phosphine Ligands

Monika Dziubelski & Katie Lowney
Advisor: Craig Anderson

Platinum(II) compounds are known to have attractive photophysical properties such as high quantum yields and long excited state lifetimes. Specifically, platinum (IV) compounds have largely been understudied in terms of luminescence. A series of fluorinated and brominated ligands were synthesized and reacted with the tetramethyl platinum precursor, $Pt_2Me_4(\mu\text{-}SMe_2)_2$ and the resulting octahedral Platinum (IV) compounds were subsequently reacted with isocyanide and phosphine ligands. These newly acquired platinum (IV) compounds were then characterized using NMR and emission spectroscopy.

Investigating Low One-Photon Absorption Polymerization for Direct Laser Writing Lithography

Ahmed Nafis Farhan, Tahmid Siddique & Kris Tulloch
Advisor: Chris LaFratta

New methods of microfabrication, such as two-photon absorption polymerization (2PA) are important for the creation of modern micro-optical, mechanical, and electrical devices. 2PA uses an ultrafast laser to polymerize a liquid resin into a solid at a precise location referred to as a voxel. By scanning the laser in the resin a 3-D shape of arbitrary geometry can be created. Microfabrication can also be done using low one-photon absorption, a more cost-effective method. The absorption spectrum shows that the photoinitiator TPO-L absorbs below ~400 nm but has very low absorbance at 532 nm. Here we present studies of the photophysics and photochemistry of TPO-L when excited at 532 nm. Along with a few other photoinitiators.

2-Caps in the Game of EvenQuads

Felicia Flores & Darrion Thornburgh
Advisor: Lauren Rose

We studied EvenQUADS, a variant of the popular card game SET. A Quad is 4 cards that satisfy a certain pattern. Our goal was to find and classify collections of cards that don't contain a Quad, called 2-caps. In particular, for each k, we classified 2-caps that contain k distinct triples of cards in the 2-cap that determine the same fourth card. This game is modeled by the affine geometry AG(n,2), allowing us to study this problem in higher dimensions.

Stop the Clock! Forgetting Event Timing Through Memory Suppression

Avery Freund, Luka Jijieshvili, Alice Knowlton, Ayesha Salman & Olivia Weeks

Advisor: Justin Hulbert

In trying to prevent unwanted memories from coming to mind, individuals have the capacity to downregulate the functionality of the hippocampus, disrupting this brain region's ability to retrieve existing memories and form new ones. Support for this claim comes from a laboratory task designed to model the direct and indirect consequences of attempts to suppress memories that are distracting, inappropriate, or upsetting. Repeatedly suppressing pre-established memories in this so-called Think/No-Think (TNT) paradigm has been shown to dampen the ability to later retrieve those memories after they again become relevant, a finding called suppression-induced forgetting. Moreover, novel events sandwiched between suppression attempts fail to become embedded in memory. This "amnesic shadow" cast over the novel events has been linked to the same underlying hippocampal downgregulation. Given that information related to time, place, and other related event features is thought to be integrated in the hippocampus, we further predict that temporal information supporting the accurate sequencing of events would be similarly impaired around when individuals engage in memory suppression. Here, we present a variant of the TNT paradigm that we devised over the summer in order to test

this hypothesis. This novel approach overcomes the limitations of more invasive procedures aimed at answering questions about the hippocampus's role in time-coding and may speak to the temporal disintegration/discontinuities often reported by individuals living through traumatic experiences (like the Covid-19 pandemic) as they attempt to control intrusive memories of the past to adaptively handle the challenges of the present.

Exploring Optical Defects in Gravitational Wave Detector Coatings

Jade Geng, Arpon Joy & Grace Sanger-Johnson
Advisor: Antonios Kontos

The Laser Interferometer Gravitational-Wave Observatory uses an interferometer with high-power lasers to measure gravitational waves from cataclysmic events in the universe, such as black-hole or neutron-star collisions. These gravitational-wave detectors are very sensitive to noise within the system, and in particular to noise due to the optical and mechanical losses of mirror coatings. Imperfect mirror coatings cause light to scatter off of the surface and escape from the collimated laser beam, which reduces the sensitivity of the interferometer. To increase the reach of gravitational-wave detectors, it is necessary for this scattering to be minimized. However, the origin of these defects are not yet well understood. To understand the origin of scattering in newly developed mirrors, we analyzed data from scattering measurements of coated samples performed with the GOLAB scatterometer. The group focused on defect scattering as a function of properties such as angle, layer thickness, and temperature.

Anaerobic Digester at Bard: HORSE AD 25 Capturing the Greenhouse Gas Methane and Closing the Food System Loop

Khadija Ghanizada
Advisor: Beate Liepert

If we want to mitigate climate change methane is the best solution because of its short lifetime.This way we see results much faster. Although methane lifetime is much shorter than carbon dioxide it is 25 times more potent than carbon dioxide. It contributed about half a degree to global warming already during industrialization.

26% of total GHG emissions comes from food production and food waste alone accounts for 8% of total GHG emissions,which means these human-caused greenhouse gas emissions could be reduced if we all stopped wasting food annually. If the global food waste was a country it would be the third largest GHG emitter after China and the United States. In the U.S. alone, the production of lost or wasted food generates the equivalent of 32.6 million car's worth of greenhouse gas emissions.

To shift these statistics, composting and capturing methane is one of the most promising solutions where food waste can undergo either aerobic or anaerobic decomposition process which is a natural process of recycling biodegradable

materials such as food waste. Compost usage can be maximized through the biodigester.

HORSE AD 25 stands for High Solids Organic Waste Recycling System with Electric output. The HORSE is a biodigester that is fed with food waste and biodegradable materials. Output is a bio fertilizer and biogas that can be used as a gas to create thermal heat, or electricity. With 40 tons/yr of organic food waste as input, the output is 1,400 therms/year of hot water, or 11,400 kWh/yr of electricity. And 8,500 gal/yr of biofertilizer. This particular HORSE design investigated in this BSRI has the capacity to digest 960 pounds of food waste a week and produces 140 gallons of liquid fertilizer. Based on our calculations from 960 pounds of food waste per week we can produce 139 kilowatts of electricity. We calculate for our soccer field the digester can light 28 soccer field LED light bulbs for ten hours in a week.

This way we are able to capture the greenhouse gas methane that our food waste produces and produce electricity from it before emitting carbon dioxide. Furthermore, the fertilizer can be used on the Bard Farm and sequester an additional portion for the emitted CO2 through improved plant growth.

Enhanced Text Simplification via Fusion of Multiple Neural Translation Models

Tina Giorgadze, Elliot Harris & Nadia Mehjabin
Advisor: Sven Anderson

Sentence-based text simplification reduces the lexical, semantic, and syntactic complexity of a sentence while maintaining most of its original meaning. It has numerous applications and benefits, such as helping young and non-native speakers and making medical or legal documents more readable. Our research builds upon previous work by combining expert knowledge with existing sentence simplification pipelines based on neural machine translation. Specifically, we take existing pairs of original and simplified sentences and simplify the original by identification of complex words, generation of alternatives, and then a selection and ranking of those alternative words. We simplify sentence structure using a set of rules that break down each sentence into multiple sentences each containing only one main idea. The transformed data is used to train neural networks that generate further simplifications, primarily via lexical simplification. These sentences are fused to generate new simplified sentences, which are then ranked, yielding a final optimal simplification. Simplifications will be evaluated using human workers on Amazon Mechanical Turk.

Extracting Reaction Components during Halide Exchange of CsPbX3 Nanocrystals using NMF Decomposition of X-ray Total Scattering Data

Farman Hossain Sayem & Meherin Hossain
Advisor: Matthew Greenberg

Measuring the time evolution of reaction components during nanocrystal synthesis is essential for studying nanocrystal formation mechanisms. X-ray synchrotron measurements of the real space pair distribution function G(r), the deviation from the average number density at a pair distance r, provide a histogram of the interatomic bond distances in a sample. This technique can simultaneously provide information on amorphous, nanocrystalline, and bulk crystalline atomic structure. During in situ measurements, reactant, intermediate, and product structures all contribute to the observed G(r). A model independent data reduction protocol to quickly identify the key structural components from X-ray total scattering measurements using Non-Negative Matrix Factorization was developed and tested on X-ray total scattering measurements of perovskite nanocrystal halide exchange.

In vitro Interactions of Nucleic Acids with Ruthenium Metal Complexes

Nataniel Janer Pagan & Sage Saccomanno
Advisor: Swapan Jain

An important target in cancer has been the folic acid pathway in which the enzyme dihydrofolate reductase (DHFR) catalyzes the reduction of dihydrofolate to tetrahydrofolate using NADPH, which is an essential cofactor for the biosynthesis of purines, thymidylate, and several amino acids. Our project focuses on the binding affinity of ruthenium and platinum complexes with DHFR DNA, DHFR mRNA, and DHFR enzyme. Our project revolved around the following question: What is the binding strength of RAPTA-C, LM 5400, and COMP B to DHFR mRNA, DHFR protein, and DHFR DNA. The in vitro binding affinity of RAPTA-C, LM 5400, COMP B complexes with RNA was investigated using DHFR enzyme activity assay. Despite some difficulties and delays, we were able to come up with valid conclusions in regards to DHFR DNA and Ruthenium complexes, in particular Cisplatin, which we used as a standard. Our methods included seed cultures, plasmid extraction, restriction digestion, isoamyl:phenol:chloroform purification, transcription, incubation with metal complexes, translation, analysis with a DHFR activity assay along with gel electrophoresis. We concluded that ruthenium complexes are able to bind RNA and DNA sequences hindering the enzymatic activity of the DHFR enzyme.

Future work will revolve around more studies with the additional ruthenium metal complexes that we were not able to get to this summer, from the Anderson laboratory. These studies will need to be done in triplicates in order to be certain of our findings.

Inhibition of CRISPR Activity by Transition Metal Compounds

Macy Jenks

Advisor: Swapan Jain & Craig Anderson

Transition metals such as ruthenium and platinum have been utilized to produce compounds that show potential in anticancer trials as chemotherapeutics. Here we investigate a variety of ruthenium and platinum compounds, some commercially available and some novel, to examine their binding to DNA and RNA. Binding of compounds to nucleic acids may have the potential of modulating their function. Our lab has developed a CRISPR-Cas9 model system. In this work, we investigate whether target DNA and guide RNA binding to these compounds can affect CRISPR activity under varying compound concentrations, buffers, and pHs.

Fungal Pathogencity Trials:
Do Soil Fungi Kill Seeds of Many Species?

Yadriel Lagunes
Advisor: Cathy Collins

In a warming climate and fragmented landscape, investigating soil-borne fungal pathogenicity is important for understanding how plant fungal pathogens affect an ecosystem in the present and predicting how they will affect the environment as the climate crisis progresses. According to the Disease Triangle model, disease is the result of the relationships between a pathogen, host, and the environment; therefore it is reasonable to predict that a changing environment could also impact the relationships between a pathogen and host. Previous research suggests that specialist plant fungal pathogens contribute to biodiversity in a landscape by targeting only specific species, which gives other species the opportunity to grow. In our experiment, we determined the pathogenicity of 10 fungal taxa found in the Kansas landscape based on the difference in seed survival rate between control plates and plates exposed to fungus over approximately 30 days. We tested the pathogenicity of each fungus on 12 native seed species to evaluate whether the fungal taxa was a specialist that selectively killed a few species of seeds or a generalist that killed a variety of species. We look forward to the results of this ongoing and publishable research.

A Closer Look at Projective SET

Josef Lazar
Advisor: Lauren Rose

This summer I studied a game called Projective SET. It is a mathematical system similar to that of SET. An example of this is the game Socks, where every card has anywhere between 1 and 6 socks that are red, pink, green, blue, purple, or yellow. A group of three cards that has an even amount of socks of each color is a SET. My goal was to study collections of cards that didn't contain any SETs. I will present here some of the results I found.

Synthesis of Isocyanide Compounds with Cyclometalated Platinum Compounds

Ryan Lum
Advisor: Craig Anderson

Cyclometalated platinum compounds were synthesized by substitution of the isocyanides, 2- Naphthyl Isocyanide and 1-Adamantyl isocyanide, for dimethyl sulfide with a previously reported cyclometalated platinum. These newly synthesized compounds were characterized, and their photophysical properties were measured. The compounds' characterization included multinuclear NMR spectroscopy, absorbance spectroscopy, and emission spectroscopy.

Photocatalytic C-N Bond Formation: Mechanism and Scope of Alkene Aziridination with N-aminopyridinium Ylides /

Ligia Monterroza Orellana, Max Schultz, Aya Shaheen & Abena Wirekoh
Advisor: Emily McLaughlin

Carbon-nitrogen (C-N) bonds are ever-present in both natural and unnatural small molecules, especially those with potential bioactivity. Our research group has been interested in developing new synthetic methods to create two C-N bonds, simultaneously, to afford substituted aziridine products. This work focuses on the design of a visible light-driven process where a metal photocatalyst alongside blue LED light promotes the direct aziridination of substituted alkenes (C=C) using N-aminopyridinium ylides as the nitrogen source. Reports in the literature have recently proven that nitrenes can be generated from azidoformates using visible light catalysis and will form aziridines in the presence of olefins. To better understand this process and how it relates to other electrophilic amines, we are currently investigating ylides derived from N-protected aminopyridinium salts. The effects on stoichiometry, electronics of the nitrogen source, and the identity of the alkene reaction partner are observed through NMR studies and reported here.

Synthesis of Ruthenium (II)-Arenes Complexes and Fluorinated Cycloplatinated (II) Complex

Annie Moulene
Advisor: Craig Anderson

Ruthenium (II)-arenes complexes are currently being explored for their potential anticancer agents due to their ability to bind to biological targets. Fluorinated cycloplatinated complexes are being investigated as fluorinated ligands show promising improvement of existing cycloplatinated complexes. We attempted to make four ruthenium complexes that could be used to investigate their interactions with biomolecules and eventually as anticancer agents. Microwave synthetic techniques were employed to obtain our complexes, and they were purified by chromatography. The complexes were then characterized by NMR spectroscopy. We were successful in obtaining two compounds and also attempted to grow crystals of the products. Future work with these complexes would include investigating how to optimize each compound's synthesis and increase their percent yield, as some yields were quite low. We plan to investigate their photophysical properties as well as explore how these metal complexes interact with RNA.

Visible-light Promoted Synthesis - Intramolecular [2+2] Cycloadditions of Vinylogous Esters and Amides

Sadia Mustofa & Nye Pichkhadze
Advisor: Emily McLaughlin

In this work we target new methods to prepare the cyclobutane carbon scaffold, a structural feature found in both natural and artificial molecules. It has long been known that cyclobutane rings can be synthesized from two carbon-carbon double bonds through activation with ultraviolet (UV) light; however, UV light sources are expensive, hazardous to use, and often lead to uncontrollable reactivity. To avoid the challenges of using high-energy UV light, our reactions were carried out under lower energy visible light (blue LEDs). In this project, we report on investigations of the intermolecular [2+2] cycloaddition of a functionalized vinylogous ester and amide heterocycles with simple alkene coupling partners. We base this work on previous cycloadditions accomplished in our laboratory featuring heterocycles with both an electron deficient and electron rich substitution. Results, to date, will be reported. The scope of this work will include efforts to understand the mechanism by which this cycloaddition occurs.

Does Variability in the Growth Rate Differ within and Among Fungal Taxa?

Martha Pasatiempo
Advisor: Cathy Collins

When a landscape is fragmented, the ecosystem and microbiome of the soil is altered drastically; it is important to understand the effects of fragmentation on soilborne fungi because they drastically affect plant diversity by killing seeds. “Edge effects,” different conditions experienced by the outer edges of ecosystems, occur when a landscape is fragmented. For instance, often soil temperatures are higher on exposed edges. In this study we sought to find out if fungi identified as the same species, but living in different parts of the landscape, grew at different rates. To do this we used fungi isolated from seeds buried for a year in edges or patch interiors of a fragmented landscape. We found that fungal growth rate varied among individual fungi within a species, but the amount of that variation differed among These results suggest that fungi growing in different locations may grow at different rates. Not only are we characterizing aspects of fungal biology never before measured, but our results suggest that if fungal growth rates relate to disease severity, the impacts of fungal disease on seeds may differ across human-altered landscapes.

Thermodynamic Characterization of HetR-PatS Reactions Using ITC

Elan Emmanuelle Ricarte
Advisor: Swapan Jain

When faced with a lack of environmental nitrogen, the cells of the cyanobacteria Anabaena sp. PCC 7120 selectively undergo heterocyst differentiation to form cells that can fix atmospheric N 2 . Among the main players of this process are the DNA-binding upregulator protein HetR and the PatS5 peptide (RGSGR), which binds to HetR to prevent it from binding to DNA. The specific molecular mechanisms that take place during the protein-peptide binding reaction are still unknown. The objectives of our Bard Summer Research Institute project was to purify HetR protein and determine the binding affinities and the saturation curves of the binding reactions of HetR and PatS peptides, including mutants, using isothermal titration calorimetry (ITC). Isothermal titration calorimetry tracks the microjoule changes in enthalpy during a reaction. The results are that 0.4 mg/mL of HetR protein has been successfully purified and the binding affinity and the thermodynamic saturation curve of the HetR-PatS6 peptide (ERGSGR) binding reaction have been measured. Future work will focus on thermodynamically characterizing other HetR-PatS reactions, and testing how the different PatS peptides inhibit HetR using electrophoretic mobility shift assays.

Fun With Quads

Daniel Rose-Levine
Advisor: Lauren Rose

This summer research was about the card game Quads, as well as other SET-related games such as SET and Projective SET. We looked at certain features of the game Quads, such as the covering equations, finding small complete caps, k covers, maximal caps, and equivalence classes of caps–and also applied some of these techniques to SET and Projective SET to get analogous results..

Practical TPP Improvements

Quincy Ross
Advisor: Chris LaFratta

The ability to automatically focus a laser on a surface would be of great practical utility in two-photon polymerization (TPP). By shining an asymmetric laser through the objective lens you can adjust the focal point until the image of the laser becomes a point, at this point it should be focused at the surface. Another practical ability is being able to image an opaque sample. This can be done using epi-illumination, which is illuminating a sample from above rather than through. The illuminating light must be manipulated to enter the microscope with a wide field evenly illuminate the entire sample. The progress toward both of these improvements, the autofocus and the epi-illumination, are described.

Does Growth Rate of Fungal Pathogens Influence Disease Severity on Seeds?

Ella Skinner-Sloan
Advisor: Cathy Collins

As global temperatures rise, it is imperative to understand the relationship between temperature and disease severity. Soil-borne fungal pathogens cause disease in seeds, impacting germination success. Since energy is limited, a trade-off may exist for fungal pathogens between growth rate of the pathogen and its ability to cause disease. Growth rate, in turn, may be impacted by temperature. As part of a larger study examining the role of seed pathogens in plant communities, we tested the effect of temperature on fungal growth rates, and the impact of fungal growth rates on disease severity in seeds. Using fungi cultured from seeds buried underground for a year, we measured growth rates for ten different fungal taxa at two temperatures for seven days. We also measured the impact of fungi on seed survival by calculating the difference in seed germination between seeds grown with fungi and seeds grown without (controls). We found that temperature influences the growth rate of fungal pathogens; most fungal taxa grew faster in warmer temperatures. In addition, for two plant species, disease severity increased at warmer temperature showing that temperature impacts disease via growth rate. Our research suggests that climate change may alter disease-host interactions, potentially impacting food systems and plant diversity.

Chemical Characterization of Treated Wastewater Effluent

Serra Sonmez
Advisor: Emily White

Communities are faced with the challenging task of sustainable water resource management, including the effective treatment of wastewater. While it is common practice for treated wastewater to be discharged to nearby surface waters, the specific impacts on water quality and ecosystem health are not always well understood. As a first step towards exploring the potential for treated wastewater to influence the water quality of receiving waters, the chemical composition of several effluents were determined. Single grab samples were collected from the discharge pipe of the treatment plants at Bard College and three nearby communities (Dutchess and Ulster County, New York) in July 2022. Temperature, conductivity, pH, and dissolved oxygen were measured in the field and samples were tested for fecal indicator bacteria (*E. coli* and total coliform). Laboratory analyses were conducted to determine the concentration of cations, anions, nutrients, carbon, and metals. Differences observed in the effluent samples highlight the need to consider the treatment processes used at each plant. Routine monitoring of the effluent and receiving waters is needed to evaluate the spatiotemporal variability of the relationship between the natural and anthropogenic factors that control water quality. Such information will enable communities to make better decisions about water use and policy.

Analysis of NuSTAR X-ray Observations of Sgr A* during 2016-2021

Rose Xu
Advisor: Shuo Zhang

At the center of most galaxies lies a supermassive blackhole. Sagittarius A*, the supermassive blackhole at the center of the milky way, exhibits a recurring behavior not seen in other supermassive blackholes: short flaring activities. Using 32 observations from the NuSTAR X-ray space telescope from 2016 to 2021, I produced filtered images of Sagittarius A*, performed astrometric correction on the images, trimmed and plotted light curves from the r=50" region, and gained preliminary results on the 5 newly detected flares between 2016 and 2021. Out of observation data with a total of ~1.12 Ms exposure time, I detected flares lasting ~15ks in total, including a very exciting double-peak flare. Although lots of the observations include no flares, they turn out to be ideal for the future study of a new and mysterious galactic feature which locates less than 3.3 light years away from Sagittarius A*.