Student Symposium

Saturday, April 9, 2022

Schedule Overview

Saturday, April 9, 2022

Refreshments, 9:30 – 10 a.m.

Morning Poster Session, 10 – 11 a.m.

Orange Carpet

Ciera L. Davis & Daniel Burford Jr.
Nina Deer
Emmaline Fievet
Makayla Kelleher
Justyna Kruczalak
Abigail Lindenfeld & MkpoutoAbasi James
Alie McEndaffer
Erin McNamer
Marcus Quirk
Mansour Sims
Sydney Swift & Keva Tomas
Nolan Zeger

Oral Presentations Session I, 11 – Noon

Russell Room

Moderator: Jim White — William Alvey; Michael Coester; Clara Haverstic

Hedges

Moderator: Niloofar Kamran — Trisha Dube; Amy Talman; Laura Zonarich

Schedule Overview

Lunch, Noon – 1 p.m.

Remarks by President Jonathan Brand and Provost Ilene Crawford

Smith Dining Room

Oral Presentation Session II, 1 – 2 p.m.

Russell Room

Moderator: Barbara Christie-Pope — Kate Abrams; Jonathan Azenon; Gwen Paule, Madalyn Morris, & Robyn Luchesi

Hedges

Moderator: Belou Quimby — MaryEllen Hinken; Elise Kalin & Emily Bjerke; David Navarro

East Hall-Perrine

Moderator: Jen Rouse — Markie're Allen; Clara Haverstic; Alina Moore

Afternoon Poster Session, 2 – 3 p.m.

Orange Carpet

Kate Abrams

Markiere Allen

Jonathan Azenon

Lilian Heinzel

Mia McCoy, Clara Haverstic & Lauryn Legeer

1. Madalyn Morris & Avelene Schesser
2. Connor Rittner
3. Keegan Schultschik
4. Frank Vega Velazquez
5. Randy Young

Oral Sessions

Morning Session

Moderator: Jim White

Russell Room

Send in the Clowns: The Form and Function of Political Comedy
Politics
Author: Clara Haverstic
Sponsor: Megan Goldberg

Egypt's Success over Article 7b
Religion
Author: Michael Coester
Sponsor: Chris Hoklotubbe

Borderlands, Militant Masculinities, and Machismo in Herbert Siguenza's *El Henry* and *1 Henry IV*
English & Creative Writing
Author: William Alvey
Sponsor: Kirilka (Katy) Stavreva

Moderator: Niloofar Kamran

Hedges

Haloes and Crowns: A Deeper Understanding of Basquiat's Iconic Symbols
Art & Art History
Author: Trisha Dube Sponsor: Chris Morris Penn-Goetsch

Artemisia Gentileschi's Self-portrait: An Artist in the Making
Art & Art History
Author: Amy Talman Sponsor: Chris Morris Penn-Goetsch

The Pre-Raphaelite Pandora
Art & Art History

Author: Laura Zonarich
Sponsor: Chris Morris Penn-Goetsch

Afternoon Session

Moderator: Barbara Christie-Pope

Russell Room

Design of a Course to Further Enhance Preparation of Prehealth Students for Communicating Across Difference
Chemistry and Religion
Author: Kate Abrams
Sponsor: Jai Shanata and Chris Hoklotubbe

Developing a solvent system to deliver hydrophobic peptides to bacteria cells grown in a liquid media.
Chemistry
Author: Jonathan Azenon
Sponsor: Jai Shanata

Using Data to Fight a Pandemic Locally: Development and Use of COVID-19 Metrics Development and Use of Metric-based COVID-19 Data Reports: Change In Perspective
Chemistry and Mathematics & Statistics
Authors: Gwen Paule, Robyn Luchesi, & Madalyn Morris
Sponsors:Brandi Shanata & Jai Shanata

Moderator: Belou Quimby

Hedges

Monument and Memorial in Albuquerque's *Cuarto Centenario*: *La Jornada* and *Numbe Whageh*
Art & Art History
Author: Maryellen Hinken
Sponsor: Chris Morris Penn-Goetsch

Are you, like, totally buggin'? : Language Policing and the Vilification of "Like"
English & Creative Writing
Authors: Elise Kalin & Emily Bjerke
Sponsor: Katie Sagal

An Enquiry into the Motivations Behind the Initial Government Funding of a Police Force
English & Creative Writing

Author: David Navarro
Sponsor: Kirilka (Katy) Stavreva

Moderator: Jen Rouse

East Hall Perrine

Lost and Found in Translation: An Actor's Approach
Theatre & Dance
Author: Clara Haverstic
Sponsor: Patrick Du Laney

Origins of Racism
Mathematics & Statistics
Author: Markiere Allen
Sponsors: Jim Freeman & Hemie Collier

The Art of Handling Raptors
Biology
Author: Alina Moore
Sponsor: Tammy Mildenstein

Poster Presentations

Morning Session

1 **Too Hot to Handle? Can Algae Cells Save Coral from Global Warming?**
Biology
Author: Ciera L. Davis & Daniel Burford Jr.
Sponsor: Craig Tepper

2 **Trust the process: Development of a mental skills training program and wellness protocol at a Division III institution**
Kinesiology
Author: Nina Deer
Sponsor: Christi Johnson

3 **Measuring Membrane Heterogeneity of Binary and Ternary Lipid Systems**
Chemistry
Author: Emmaline Fievet
Sponsor: Jai Shanata

4 **High fat diet exposure to Long Evans rats impacts memory, locomotion and marble-burying behaviors**
Psychology
Author: Makayla Kelleher
Sponsor: Steven Neese

5 **The Influence of Milkweed Insect Communities on Monarch Oviposition Behavior**
Environmental Studies
Author: Justyna Kruczalak
Sponsor: Tammy Mildenstein

6 **Ornate Box Turtles: Wanted Dead or Alive**
Biochemistry & Molecular Biology
Authors: Abigail Lindenfeld & MkpoutoAbasi James
Sponsor: Craig Tepper

7 **Vibrational Spectroscopy of Redox Active Molecules**
Chemistry
Author: Alie McEndaffer
Sponsor: Craig Teague

8 **Organophosphorus Medicinal Chemistry: Turn On Fluorescent Prodrugs**
Biochemistry & Molecular Biology
Author: Erin McNamer
Sponsor: Daniel Goetz

9 **Improving Travel Efficiency in Sports Leagues Using a Conference-and-Division Model**
Mathematics & Statistics
Author: Marcus Quirk
Sponsor: Jim Freeman

10 **Server Clusters: Cornell's Usage Patterns and Trends**
Computer Science
Author: Mansour Sims
Sponsor: Ajit Chavan

11 **Determining Sugar Composition of Fruit Consumed by *Pteropus mariannus* via Quantitative Methods**
Chemistry
Authors: Sydney Swift & Keva Tomas
Sponsor: Cindy Strong

12 **Using CRISPR/Cas9 to investigate grhl3 in Zebrafish**
Biochemistry & Molecular Biology
Author: Nolan Zeger
Sponsor: Barbara Christie-Pope

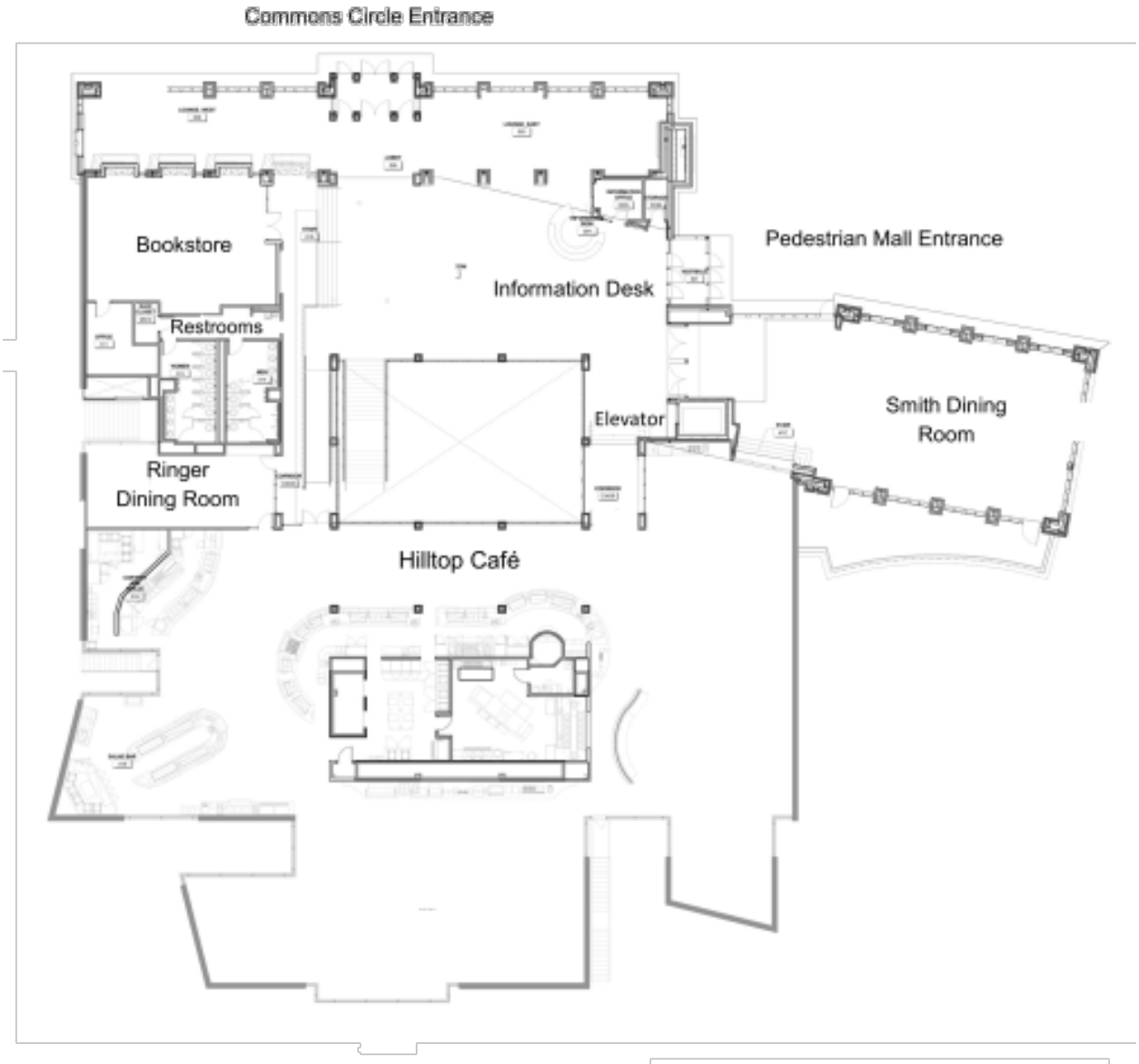
Afternoon Session

1 **Design of COVID-19 Testing Strategy Implemented on Cornell's Campus**
Chemistry
Author: Kate Abrams
Sponsor: Jai Shanata

2 **Family, Religion, and Henry Ossawa Tanner's *The Thankful Poor* (1894)**
History
Author: Markiere Allen
Sponsor: Chris Morris Penn-Goetsch

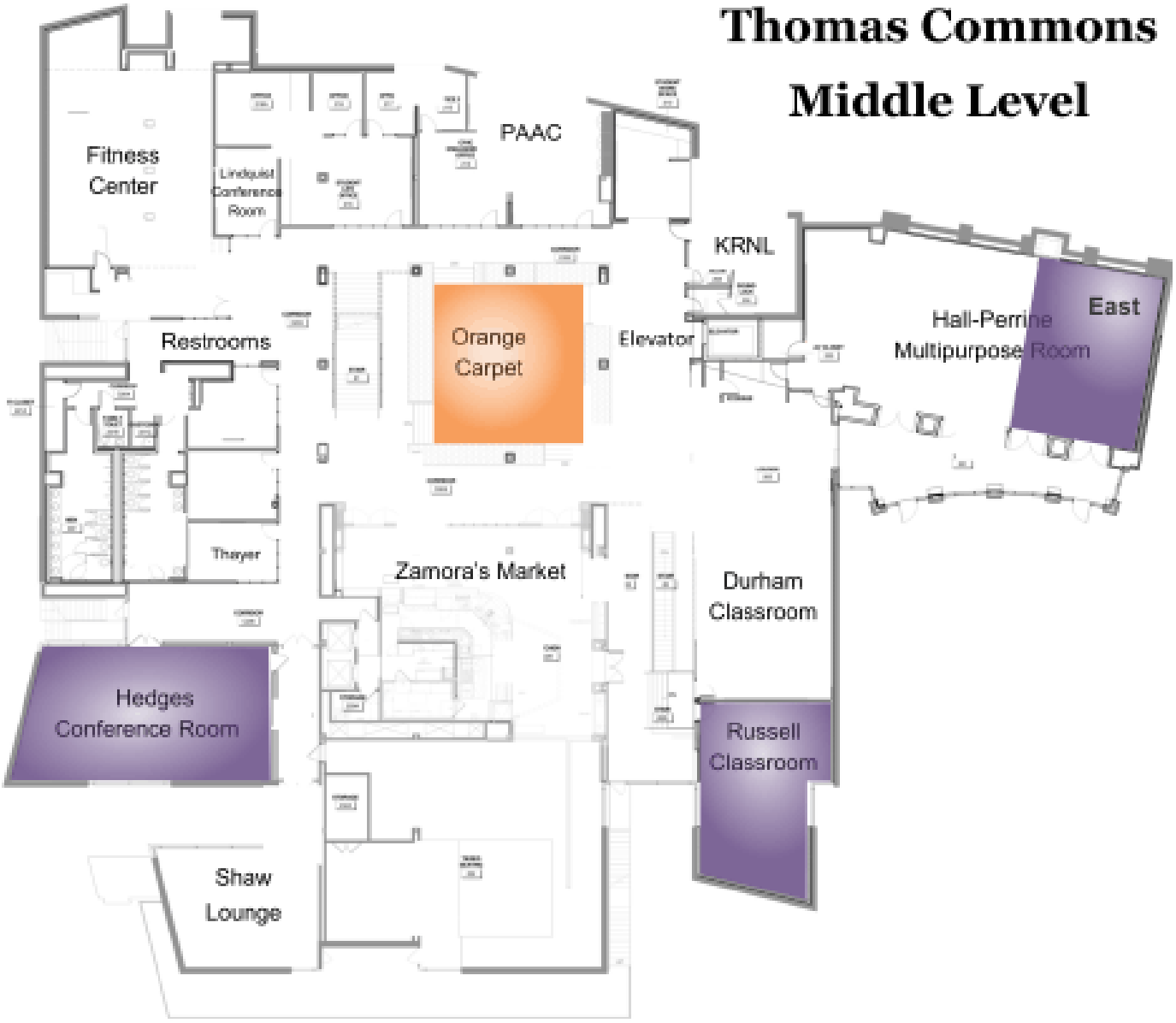
Maps

Thomas Commons
Upper Level

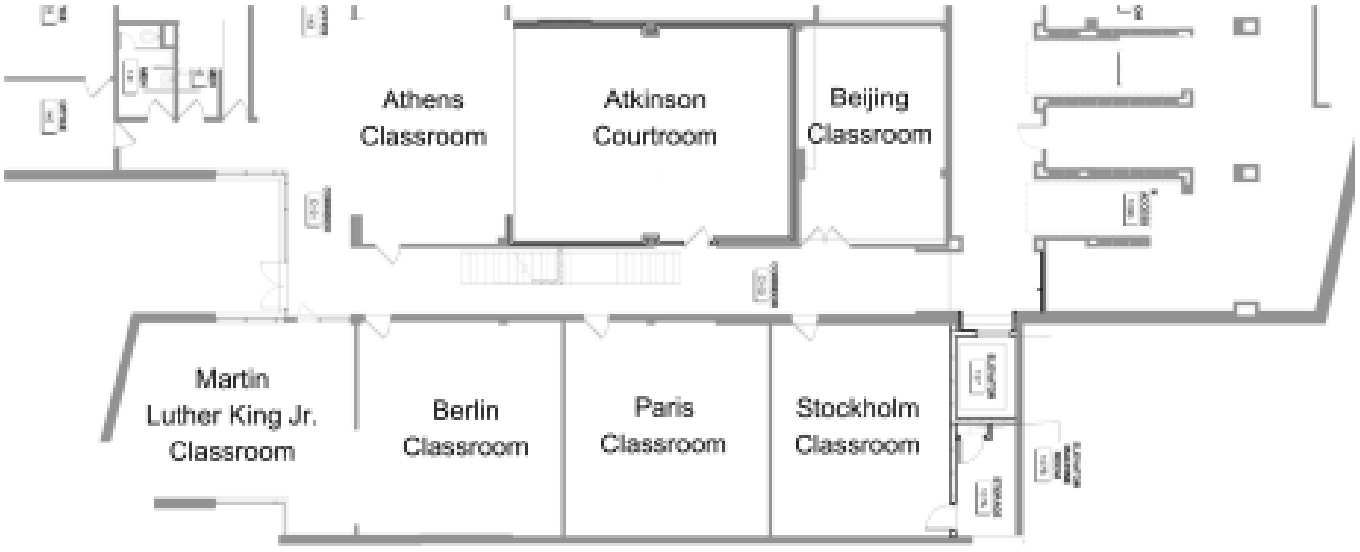


Cornell College

Thomas Commons Middle Level



Thomas Commons Lower Level



Abstracts

Kate Abrams, '23 **Northbrook, IL**
Chemistry and Religion *Sponsor: Jai Shanata and Chris Hoklotubbe*

Design of a Course to Further Enhance Preparation of Prehealth Students for Communicating Across Difference

Effective healthcare professionals balance deep knowledge of science with empathy for patients, knowledge of latest research and treatments, effective communication skills, and more. Cornell's natural science coursework prepares students well for the knowledge aspect of the healthcare profession. Additionally, the Dimensions program, through workshops, panel discussions, one-on-one advising, the Dimensions Reading Group, and more, provides insight and exploration opportunities for pre-professional careers. As a pre-health student, I sought to more fully round out these experiences through targeted academic work which further bridges the gap between the science and culture of healthcare. This has taken two forms: design of an individualized major to add to my Biochemistry and Molecular Biology major and, in block 6 of 2022, working with Jai Shanata and Chris Hoklotubbe to design a course titled Healthcare & Religion: Effective Communication.

This course emphasizes oral presentation and synchronous debate. In order to prepare students to converse about healthcare, not only should they be armed with knowledge, but they must also have a space to practice engaging with their peers about difficult content. Along with creating in-class activities such as debates, I also wrote a schedule that outlined daily activities, homework assignments, and topics being presented, and composed a series of learning outcomes rooted in Cornell's nine Educational Priorities and Outcomes as well as the Ingenuity core curriculum. Finally, I wrote a draft course description that reads as follows:

> This course takes an interdisciplinary approach to preparing students for communicating across perspectives regarding personal and societal decisions in healthcare, incorporating aspects of religion, public policy, and the natural sciences. Students will engage with subjects drawn from abortion, euthanasia, rationing of healthcare (especially pertaining to COVID-19), organ donation and transplantation, research ethics, pharmaceutical policy, vaccination policy, and the opioid crisis, through required dialogues, debates, and other synchronous activities.

Students will engage in perspective-taking of controversial ideas, sometimes articulating viewpoints that differ from their own.

Kate Abrams, '23 **Northbrook, IL**

Chemistry *Sponsor: Jai Shanata*

Design of COVID-19 Testing Strategy Implemented on Cornell's Campus

In the summer of 2020, Cornell College designed a strategy that would increase safety during the repopulation of campus in the fall, allowing for some in-person learning during the 2020-2021 academic year. One of the main prerequisites for reopening the school was campus testing for coronavirus. Given the small population (~1000 students) and resources of Cornell College, a thorough consideration of the testing options was necessary. The goal was to use available resources to conduct enough testing so that our campus R0, an indicator of how contagious an infectious disease is, could be kept below 1, meaning that even though the disease is present in the population it will decline and eventually die out. The factors we considered included the timeline for results, ease of sample collection, false positive and negative rates, cost, ability to offer the tests with available personnel and facilities, available supply of materials and equipment, among others. We researched testing methods for SARS-CoV-2 that had been granted emergency use authorization by the FDA as of early summer 2020, including the 'gold standard' PCR (polymerase chain reaction), outsourcing testing of samples collected on campus, and Point of Care testing, including a colorimetric saliva test and the Sofia SARS Antigen Test.

We recommended the Sofia SARS Antigen Test, which allows patients to collect their own nasal swab samples and provides results in 15 minutes. In collaboration with Pandemic Response Coordinator Nancy Reasland, we created a proactive strategy of asymptomatic testing of high-contact groups, cluster sampling by residence hall floor, and random sampling of faculty and staff, which was then implemented by Chase Sonnemaker '21. Cornell College administered a total of 9,876 SARS-CoV-2 tests on campus during the 2020-2021 school year. The surveillance testing on campus, along with other safety measures and limited interaction enabled by the One Course at a Time schedule, allowed us to continue in-person learning throughout the fall and spring semesters of the 2020-2021 year and have a campus-wide cumulative positivity rate of under 1.5% through Spring 2021.

Markie're Allen, '22 **Lee's Summit, MO**
Mathematics & Statistics *Sponsor: Jim Freeman & Hemie Collier*

Origins of Racism

One of the major issues that is still plaguing the United States is racism. This presentation investigates the origins of racism. To understand these origins, a clear definition of race, which is not a scientific concept, must be articulated. The definition of race used in this presentation is that race is a social construct based on the idea of otherism, i.e., to be viewed as different or unique or other. This definition of race includes culture, religion, nationality, and physical features. In this presentation, I will show how racism originates from viewing a race as less than human. With this understanding of the origins of racism, I will show how racism is manifested from early slavery due to military conquest to the racism we deal with today.

Markie're Allen, '22 **Lee's Summit, MO**
Histroy *Sponsor: Chris Morris Penn-Goetsch*

Family, Religion, and Henry Ossawa Tanner's *The Thankful Poor* (1894)

This personal response to Henry Ossawa Tanner's painting, *The Thankful Poor* (1894), was part of a catalogue entry assignment for an African American Art History class taken in the spring of 2020. The painting communicates the centrality of Black history and religion as a foundation for survival. It also demonstrates a grandfather's love and the importance of the family. The intimate moment illustrated also shows the importance of gratefulness and hope–the hope that things can get better despite the struggles that many have to go through every day. Struggles that we can relate to today.

William Alvey, '22 **Savage, MN**
English & Creative Writing *Sponsor: Kirilka (Katy) Stavreva*

Borderlands, Militant Masculinities, and Machismo in Herbert Siguenza's *El Henry* and *1 Henry IV*

Herbert Siguenza's adaptation of Shakespeare's history play *1 Henry IV* (1598), titled *El Henry* (2014), upholds themes of the early modern original about the ideal military man and the conflict among rebel barrios, but reinvents such themes within the context of a Chicano cultural sphere. To unpack this cultural context, I have investigated the Chicana feminist ideas of machismo from

writings of Maxine Baca Zinn and Gloria Anzaldúa who define machismo as a very real, but nebulous, institution that has led to often-misunderstood, hyperbolized, and stereotyped portraits of Latino men. Macho ideals are upheld with both plays in the characters Hotspur/El Bravo, Prince Hal/El Henry and King Henry/El Hank. Machismo's place within modern Latinx culture–that includes the theatre world created by Herbert Siguenza for *El Henry*–allows for an analysis of masculinity studies and an introspection into how such toxic masculinity affects women, and, on a grander scale, how Chicano masculine ideas can harm women who attempt to define a space for themselves within the Chicano community. In Siguenza's play, borders that divide Chicano life from the Gringos to the east, as well as the borders between rival gangs within the invented setting of Aztlan City, are a major facet of the conflict of the Mad-Max-esque play, and a representation of contemporary border discourse within the United States. I analyze the toll these borders play in cross-cultural conflict and Eurocentric authoritarianism, and further, how militant masculinity, or machismo, is the result of such border conflict.

Analyzing Shakespeare's and Siguenza's men as caricatures of masculinity allows for reflection on how militant masculinities harm not only the community, but also the family. Studies of the roots of such militant masculinities can allow, now and in the future, for continued development of masculine studies as an offshoot of feminist studies, and contribute to the ultimate goal of equality across gendered and racialized borderlands.

Jonathan Azenon, '24 **Culpeper, VA**
Biochemistry & Molecular Biology *Sponsor: Catherine Volle*

Turning Up the Heat: Exploring the Vulnerability to Temperature Changes in the Predatory Bacterium *Bdellovibrio bacteriovorus*

One of the biggest threats to public health safety is antibiotic resistance. Currently, in the US, more than 2.8 million antibiotic-resistant infections occur per year. These resistant infections have driven scientists to look for new and interesting ways to kill bacteria. In this search, scientists have found antimicrobial peptides (AMPs), which are a part of the innate immune system. Magainin 2 (MAG2) is a specific AMP that targets the bacterium cell membrane. When a certain concentration of MAG2 is reached, it inserts itself into the membrane and creates pores that are fatal to the bacterium. We used MAG2 as a test of how vulnerable the bacterial membrane is to attacks from an innate immune system. The predatory bacterium *Bdellovibrio bacteriovorus* preys on Gram-negative bacteria. This makes *B. bacteriovorus* a promising candidate for a "living antibiotic" that could be introduced into the human gut microbiome to help treat a variety of diseases. However, in the laboratory, *B. bacteriovorus* is grown at 30°C rather than physiological temperature (37°C). Additionally, when introduced into various animal microbiomes, *B.*

bacteriovorus fails to establish itself within the organism's microbiome. Given the temperature difference between *B. bacteriovorus* grown in the laboratory and physiological temperature, we wondered what effects this change in temperature has on *B. bacteriovorus*'s ability to survive in an organismal microbiome. To test this vulnerability, we grew *B. bacteriovorus* at 30°C and at 37°C and tested its susceptibility to MAG2. Using fluorescent spectroscopy we observed that *B. bacteriovorus* grown at 37°C is indeed more susceptible to MAG2 inserting into the membrane. Interestingly, *B. bacteriovorus* grown at 37°C starts to produce a yellow compound called Ubiquinone-8 (UB-8), which previous research has shown might be linked to a more vulnerable membrane. We wanted to quantify the expression of the UB-8 gene when *B. bacteriovorus* is grown at 37°C over a seven-day period using a Qualitative Polymerase Chain Reaction, but were only able to collect the samples and test for two days before the study ended. Learning more about the role of Ubiquinone-8 in the cellular membrane, as well as other possible weaknesses, will help further *B. bacteriovorus* as a possible candidate for a living antibiotic.

Jonathan Azenon, '24 **Culpeper, VA**
Chemistry *Sponsor: Jai Shanata*

Developing a Solvent System to Deliver Hydrophobic Peptides to Bacteria Cells Grown in a Liquid Media

Powerful conclusions can be reached when a hypothesis is supported by experimental data derived using multiple techniques, especially when drawn from different disciplines. In some cases, experiments in chemistry are subjected to scrutiny for their relevance in a biological system. With this in mind, we sought to demonstrate physiological relevance to the bilayer findings of our lab by constructing an experimental biological model. Gramicidin A (gA) is an antimicrobial peptide produced by *Bacillus brevis*. This peptide forms ion-conducting pores in membranes and its action has been thoroughly characterized. We use gA in our existing experimental model to test the effects of drugs and diet on lipid bilayer physical properties. In order to demonstrate the direct physiological relevance, we tested gA activity at high concentrations against a gram-positive bacteria, *Staphylococcus epidermidis*, to see if it would inhibit the growth of the bacteria. If the growth was inhibited, this would suggest that gA had inserted itself into the membrane of the bacteria and formed pores, destabilizing the ion balance of the bacteria. To create this model, we must first secure a way to deliver gA to the target bacteria. The first step in developing this model was to find a suitable solvent for gA, which is extremely hydrophobic, to allow for delivery to bacteria that live surrounded by water. Short-chain alcohols, including ethanol, are known to be effective solvents for gA but are bactericidal at some concentrations. To distinguish which molecule–alcohol or gA–is killing the bacteria, we needed to find a mixture that is sufficiently

hydrophobic for gA to dissolve in reasonable concentrations without exhibiting lethal effects on bacteria. After multiple trials, we have developed a mixture of ethanol and 1-butanol that delivers the gA to the bacteria, as well as created an alcohol minimum inhibitory concentration database. This database allows us to create different biological models to help deliver hydrophobic molecules to biological systems, thus applying a finding across disciplines.

Michael Coester, '23 **Lisbon, IA**

Religion *Sponsor: Chris Hoklotubbe*

Egypt's Success over Article 7b

Ongoing criticism towards international policies related to the acquisition of cultural antiquities originates from the large number of instances where artifacts have been illegally or unethically obtained. This is due to misinterpretations of cultural policy laws and the vague wording of laws that allow criminals to avoid punishment for their actions. As a result of these frequent controversies, critics believe there needs to be greater enforcement of internationally agreed upon rules and regulations, as well as additional policies that address the individual and organizational ethical procurement of artifacts that have cultural and religious significance. Despite the attempt by the 1970 UNESCO (United Nations Educational Cultural and Scientific Organization) Convention to address the legal and ethical procurement of cultural artifacts, the regulations internationally agreed upon at that convention continue to lack clarity and enforceability. This lack of clarity and enforceability is most clearly demonstrated in Article 7b. This presentation first examines the current UNESCO policies that address retention and reclamation of cultural antiquities, and their current weaknesses. It will then elaborate on Egyptian antiquity laws that have been adopted in order to successfully protect all antiquities in that country. Next, an argument will be made that the strong guidelines set by Egypt should be adopted by the rest of the world. The presentation will then elucidate weaknesses and obstacles that Nigeria needs to address in order to improve upon its current cultural antiquities programs. Finally, it will offer a suggestion as to how the United States can further improve its success by following the example set by Egypt.

Ciera L. Davis, '22 — **Nassau, Bahamas**
Daniel Burford Jr., '22 — **Bolingbrook, IL**
Biology — *Sponsor: Craig Tepper*

Too Hot to Handle? Can Algae Cells Save Coral from Global Warming?

Coral are marine invertebrates that belong to the *Cnidaria* phylum and are composed of many small polyps that collectively make one large coral colony. Coral are primarily responsible for laying the foundations for reef structures found in shallow ocean waters. Reefs are very important to many ecosystems as they provide revenue from tourist attractions, prevent erosion, and act as habitats for many organisms.

Although coral are carnivores that feed on phytoplankton, they contain small symbiotic photosynthetic algae, called *Symbiodinium*. The symbionts receive shelter by residing in the coral and, in return, the coral obtains photosynthetic nutrients. These symbionts reside within the tissues of coral polyps and provide coral with its color and nutrients. Genetically distinguishable clades of symbionts (clades A, B and C) provide different physiological benefits to the coral, such as more resistance to increasing sea surface temperatures.

Coral are very temperature sensitive and can only survive in a narrow temperature range. Coral expel their symbionts due to the stress from the heat and turn white, giving coral a bleached appearance and loss of their main nutrient source, which the symbionts provide.

We used coral species *Millepora complanata* and *Millepora alcicornis* (fire coral) as a model system to examine global warming effects on coral bleaching. Using DNA fingerprinting, we examined coral symbiont populations from two thermally-different locations in the Caribbean to determine if coral colonies changed their dominant symbionts in response to rising sea surface temperatures. Millepores residing in the cooler waters (22-28℃) of The Bahamas (2013-2019) were *Symbiodinium* clade B dominant (100%; N=103) and did not show signs of bleaching. Belize (2013-2019) Millepores, experiencing warmer sea surface temperatures (26-30℃), were mostly *Symbiodinium* clade A dominant (72%, N=60) and also did not show signs of bleaching. However, some *Symbiodinium* clade B-dominant Belize Millepores (28%, N=35) showed signs of bleaching. For the first time in 2020, two colonies (N=86) of Millepores from The Bahamas were *Symbiodinium* clade A dominant. Our results may suggest that Millepores in The Bahamas could be reacting to thermal stress events by beginning to switch their symbiont populations.

Nina Deer, '22 **Highland Park, IL**
Kinesiology *Sponsor: Christi Johnson*

Trust the Process: Development of a Mental Skills Training Program and Wellness Protocol at a Division III Institution

Building and maintaining a robust set of mental skills is crucial for sport performance and supports general well-being (Williams & Krane, 2021). While sport psychology services are often available within NCAA Division I programs (e.g., Wrisberg et al., 2010), athletes in other NCAA divisions have fewer resources for both sport psychology and mental health. Having a community to support athletes' journeys to elite performance is essential. Because college athletes, regardless of level of play, should be provided with much-needed tools to support mental skills, the purpose of this project was threefold: first, to explore coaches' and athletes' attitudes toward mental skills and wellness programs at a small Division III college; second, to design a coaching education program for those coaches; and third, to propose a mental health check-point for the college's athletic department.

Coaches (n=4) and athletes (n=10) at a small NCAA Division III college were interviewed about their attitudes, experiences, and expectations for mental skills training programs and mental health resources on campus. Interview data were transcribed verbatim and subjected to thematic analysis (Berg, 2012). Seven themes emerged including positive previous experiences, sports as an added stressor, outside stressors impacting sport performance, lack of available resources, sense of security for available resources, reduced stigma for mental health concerns, and implementation strategies.

Based on these themes, a proposal for a coach education program was developed based on Harwood's (2008) 5Cs Coaching Efficacy Program. Furthermore, the need for a mental health "checkpoint" became clear. This checkpoint was designed to help coaches discover athletes' mental health concerns and open a pathway to referral to other mental health services.

Trisha Dube, '22
Art & Art History *Sponsor: Chris Morris Penn-Goetsch*

Haloes and Crowns: A Deeper Understanding of Basquiat's Iconic Symbols

Jean Michel-Basquiat was a Neo-Expressionist street artist who later worked on more permanent forms of art such as painting and sculpture in gallery settings. In his short career, he produced numerous works of great critical acclaim and became well known for his use of symbols. These include the crown and the halo. The relationship of these symbols has not been examined closely. An article written by Scott Ferguson for *Art Encounter* in 2019 states "The crown in Basquiat's work is an interchangeable symbol." I argue that these forms play distinct roles and should not be seen as interchangeable. To illustrate these roles, I will be comparing various works featuring the crown and the halo or both. By further examining the subject matter of these paintings, I can justify why they are placed on said subjects to explain the unique roles of the two symbols. The halo focuses on martyrdom and suffering; whereas, the crown emphasizes the triumph and excellence of his subjects.

Emmaline Fievet, '22 **Bend, OR**
Chemistry *Sponsor: Jai Shanata*

Measuring Membrane Heterogeneity of Binary and Ternary Lipid Systems

Cell membranes are composed of a wide variety of lipids; variations in the lipid composition of membranes affect membrane properties including the thickness and fluidity of the membrane. Over the past several years, the Shanata lab has studied these properties using planar lipid bilayers of varying lipid composition. Over Summer 2020, COVID-19 prohibited safe lab work, so a literature review of binary (1,2-dioleoyl-sn-glycero-3-phosphocholine (DOPC) and cholesterol) and ternary (DOPC, cholesterol, and sphingolipids) bilayers was conducted to plan experiments that might elucidate the differential effects of cholesterol and sphingomyelin on lipid bilayer physical properties. Labwork commenced in Summer 2021. Cholesterol and sphingomyelin are two of many structurally diverse lipids found in cell membranes that generally increase the thickness and decrease the fluidity of lipid bilayers. Additionally, these molecules may induce phase separation–including lipid rafts–in some bilayers. These phases are sometimes referred to as liquid ordered (Lo) and liquid disordered (Ld) phases and can be created in model systems. Lo and Ld phases are known to correlate with the distribution of some membrane proteins. For example, certain membrane-bound proteins, including many signaling proteins, preferentially

partition into Lo domains, which may facilitate signal transduction pathways. The effects of lipid composition on bilayer properties were investigated using electrophysiology. Gramicidin A peptides were incorporated into planar lipid bilayers, and resulting gramicidin A dimer lifetimes were measured as a function of the percentage of cholesterol and/or sphingomyelin in the lipid-forming solutions. In order to successfully make these bilayers, several revisions were made to the Shanata lab protocols, including new lipid solvents. In 2022, we continued to revise lab protocols with the objective of forming bilayers more efficiently by varying the pre-painting procedures, fabricating a different type of lipid applicator, and attempting to form bilayers by the folded-bilayer technique. These bilayers have exhibited resistance to incorporation of gramicidin and substantial heterogeneity in events on the occasions that gramicidin does incorporate, which could indicate unique membrane structures. The projects presented here should enable the Shanata lab and others to more efficiently collect electrophysiology data to investigate the presence and properties of Lo and Ld phases in planar lipid bilayers.

Clara Haverstic, '23 **Moundville, MO**

Theatre & Dance *Sponsor: Patrick Du Laney*

Lost and Found in Translation: An Actor's Approach

The problem with words is that they mean something. This is especially true for the words of William Shakespeare. Shakespeare carefully chose his words and structured them in a way to illustrate background, character, relationships, emotions, and more. Translating his works is a complex undertaking that requires attention to word choice, word order, meaning, and cadence. Actors rely on the quality of Shakespeare's words to guide their performances, and many of the aspects essential to the performance of Shakespeare may be lost in translation. This project presents the considerations a translator must make when translating with the actor in mind. It details the inherent qualities of the original Shakespeare (such as rhythm and heightened language) and the challenges of preserving them in translations. It specifically explores German translations of *Othello* and compares different versions of the same monologue. The versions are back-translated to identify how they relate to each other and to the original. Choices made by translators are compared and judged based on how they contribute to an actor's ability to perform the work. Traditional scansion and performance techniques are applied to the monologues to illustrate the challenges of translating and performing translations. Ultimately, this project aims to present translation through the eyes of an actor.

Clara Haverstic, '23 **Moundville, MO**

Politics *Sponsor: Megan Goldberg*

Send in the Clowns: The Form and Function of Political Comedy

Political satire has a rich history. In the early days of American politics, political cartoons were used as a tool in newspapers to lambast the government and to serve as propaganda. Today, comedy is still used as a vehicle for political opinion, and political satire has made its way from the pages of newspapers to our televisions. Information and entertainment have become perfectly entwined on shows such as John Oliver's *Last Week Tonight* and *The Daily Show* with Trevor Noah. Humor is used to communicate news, criticize government, and influence the public. This project examines the history, modern use, and effectiveness of political satire, with a focus on late-night entertainment news shows. The history of political comedy in America is briefly recapped, from early revolutionary cartoons to modern day sketch shows. The use of comedy as a tool from both sides of the spectrum is examined, including how the left and the right use and respond to it in different ways. The mechanics of comedy and satire are examined for effectiveness in entertainment, persuasion, and mobilization. By focusing on the form and function of late-night news shows, political comedy is dissected and analyzed until it's proven that explaining a joke does, in fact, make it unfunny.

Lilian Heinzel, '22 **Reinbeck, IA**

Mathematics & Statistics *Sponsor: Tyler George*

Public Recreation on Wildlife Conservation Preserves

Public recreation has been shown to improve mental and physical health while promoting land preservation. Should the public recreate on land designated for wildlife conservation? In the population-dense San Francisco Bay Area, where the population is expected to grow by 2.1 million by 2040, human-wildlife interactions are becoming unavoidable. This increases the importance of understanding any impacts on wildlife by human recreation in areas designated for preservation of habitat. Three adjacent privately-managed land areas were studied for recreation's possible impact on wildlife. In these land preserves, wildlife like pumas, gray foxes, and black-tailed deer are protected with great care by land management. Camera traps were used to observe activity on or near trails and off trails for two consecutive years. In the second year, private land managers began to allow the public to recreate on the trails. To observe holistic ecosystem reactions (or lack thereof) to human presence, each niche, defined as a species group's ecosystem role and diet, and individual species activity were monitored. The niches included: predators (carnivorous animals, only subject to predation by other predators; examples: pumas and coyotes), mesocarnivores

(smaller-bodied carnivores with omnivorous tendencies like gray foxes and skunks), and prey animals (herbivores, including black-tailed deer and squirrels). The study did not find enough evidence to suggest a change in wildlife activity at the species or niche level after public recreation was permitted on trails, except for coyotes, which were intolerant.

Maryellen Hinken, '22 **Albuquerque, NM**
Art & Art History *Sponsor: Chris Morris Penn-Goetsch*

Monument and Memorial in Albuquerque's *Cuarto Centenario*: La Jornada and Numbe Whageh

Cuarto Centenario is a colonial monument made to honor Spanish Conquistador Juan de Oñate for the 400th anniversary of his entry into present-day New Mexico. The work is located in Albuquerque, New Mexico, and was paid for by the City of Albuquerque Public Art Project. This work sparked controversy and was the subject of many headlines and City Council meetings between 1997-2005. The City responded to opposition by shifting *Cuarto Centenario* to a collaborative project that was not limited to Spanish ancestry. Sonny Rivera and Betty Sabo depict Oñate and a procession of Spanish families on their journey. Indigenous artist Nora Naranjo-Morse created the landscape art *Numbe Whageh* adjacent to *La Jornada*. After the completion of the project, *Cuarto Centenario* faded from newspaper headlines until June of 2020, in the wake of the Black Lives Matter Movement, as calls to remove racist monuments resurged.

Elements of *Numbe Whageh* and *La Jornada* lead the works to function differently as monuments and memorials. Naranjo-Morse's themes, use of landscape, and natural elements push *Numbe Whageh* to effectively serve as a memorial. The dominating bronze procession of *La Jornada* creates an unbalanced power dynamic between the work and the viewer, effectively making it a monument. However, I argue that it is not Oñate's presence alone that classifies *La Jornada* as a monument, it is the scale and exaltation of colonialism. This paper examines *Cuarto Centenario* through the lens of postcolonial theory while also considering the context of contemporary issues surrounding monuments and memorials.

Elise Kalin, '23 — **Bettendorf, IA**
Emily Bjerke, '24 — **San Diego, CA**
English & Creative Writing — *Sponsor: Katie Sagal*

Are You, Like, Totally Buggin'?: Language Policing and the Vilification of "Like"

As English speakers, we are primed to regulate language deviations and prevent perceived corruptions. Linguistic policing is built into our standardized education systems; it is so ingrained in our curricula that most people are unaware that it is a form of discrimination. One of the greatest threats to "pure" Standard English, many would argue, is a villain, a word so commonplace that it is barely noticeable in everyday colloquial speech. It is a word that supposedly taints and devalues the sentences of young people everywhere – that word is LIKE. This policing targets a younger generation of English speakers despite the fact that the use of LIKE spans every generation. It is a tool that enforces conformity under the guise of language purification. Despite the demonization of LIKE, it has persisted in spoken English much longer than most assume. A question we had asked was: from a grammatical perspective, what are the important functions that allow it to endure? We explored LIKE's main roles with the goal of understanding its common usage and origins, as well as the broader implications of the myths assigned to those who use it.

We examined the roots of these myths in addition to the underlying motivations of their creation and the policing of LIKE, finding discrimination in the form of classism, racism, and sexism at its core. Continued criticism surrounding this word have transformed from overt to covert stereotyping of certain LIKE users, leading to their often unintentional and hyperbolic media counterparts. Depictions of stock characters like the Valley Girl give us insight into prejudices against the voices of young women, allowing us to understand how these myths harm and restrict women's language. This specific language critiquing perpetuates the impossible and frivolous standards imposed upon young women, reinforcing the idea that without linguistic perfection, their voices do not deserve to be heard.

Makayla Kelleher, '23 **Newton, IA**
Psychology *Sponsor: Steven Neese*

High Fat Diet Exposure to Long Evans Rats Impacts Memory, Locomotion and Marble-Burying Behaviors

Obesity rates are rising in Western populations, due in part to the consumption of energy-dense foods high in fats and sugars. Obesity affects 19.3% of children and adolescents in the U.S with upward trends expected in the next several years. Little research has established sexually-dimorphic behavioral changes that might accompany exposure to diets high in fats during development. The current study piloted the impact of seven weeks of exposure to a high-fat diet (60% calories from fat sources) in developing male and female Long Evans (LE) rats. Control rats received a standard rodent diet (14% calories from fat sources). Behavioral testing involved a hippocampally-sensitive novel placement task or a perirhinal cortex-sensitive novel object recognition task. Briefly, rats had five minutes to explore two identical objects and after one-hour delay, one object was moved (placement) or replaced with a new object (object), and object interactions were recorded for three minutes. Perseverative behaviors were also tested using a marble burying task where rats were given 15 minutes to explore a cage that contained 24 marbles. Both male and female rats fed a high-fat diet showed reduced memory for the prior placement of an object after a one-hour delay compared to control-diet exposed rats. Conversely, diet failed to impact object recognition memory in male or female rats. In addition, perseverative behaviors were impacted in female rats receiving a high-fat diet, burying more marbles than did the female control-diet rats. These findings suggest developmental exposure of LE rats to a high-fat diet impacts several behavioral parameters in a sex-specific manner.

Justyna Kruczalak, '22 **Wheaton, IL**
Environmental Studies *Sponsor: Tammy Mildenstein*

The Influence of Milkweed Insect Communities on Monarch Oviposition Behavior

The monarch butterfly (*Danaus plexippus*) is known for its annual migration from the east of the Rocky Mountains in the United States and southern Canada summer habitat to their overwintering grounds in Mexico. The eastern monarch butterfly population has declined significantly through disturbance, loss of habitat, overuse of pesticides and climate change.

The monarch butterfly is also well known for solely reproducing on the common milkweed plant. There are ten other species of insects that utilize the common milkweed plant, but studies of

monarch ecology and evolution have not considered this extended milkweed community. This study examines if the milkweed insect community contributes to the monarch butterfly decline. In order to determine whether insect communities influence the monarch population, I observed 400 common milkweed plants at four different forest preserves. The number of insects on each plant and how many of each species was documented. Observations of frass, bites, and insect eggs were also recorded. Monarch butterflies did not lay eggs onto any common milkweed plants that had high insect species richness, suggesting that milkweed insects may contribute to the decline of monarch butterfly populations.

Abigail Lindenfeld, '22 **Rochester, MN**
MkpoutoAbasi James, '24 **Beltsville, MD**
Biochemistry & Molecular Biology *Sponsor: Craig Tepper*

Ornate Box Turtles: Wanted Dead or Alive

The ornate box turtle (*Terrapene ornata ornata*) is an endangered species threatened by various factors including construction in their habitats, natural predators, and single sex dominant populations due to temperature-dependent sex determination. One way to address the population decline is to establish a captive breeding program. We hypothesize that male box turtles with colorful ornate shells are more reproductively successful. We tested this hypothesis by taking blood samples from a population of ornate box turtles found in the Hawkeye Wildlife area to compare nuclear DNA sequences and form a family tree. However, the addition of deceased individuals to the family tree was problematic due to the high degradation of nuclear DNA.

The cytochrome b gene encodes a protein also called cytochrome b. This protein plays a key role in the mitochondria, functioning as part of the electron transport chain. The cytochrome b gene is commonly used for tracing species relationships and establishing family trees because the species variability of the cytochrome b gene-sequence makes individuals distinguishable. In order to include deceased individuals in the study, we isolated mitochondrial DNA from turtle tissue samples and shell fragments and used the mitochondrial cytochrome b gene to construct our family tree.

Isolating DNA from tissue samples and shell fragments from deceased individuals proved to be challenging due to the small amounts of mitochondrial DNA present in these samples. We have determined the sequence of one deceased individual and will continue to refine our approach to the problem.

Mia McCoy, '22 — **Denver, CO**
Lauryn Legeer, '22 — **Boulder, CO**
Clara Haverstic, '23 — **Moundville, MO**
Mathematics & Statistics — *Sponsor: Tyler George*

Modeling Mask Adherence at the County Level During the COVID-19 Pandemic

Due to the polarization of society, United States county's governing bodies respond to mitigation efforts for SARS-CoV-2, more commonly known as COVID-19, differently. This research investigates which political, socio-economic, and demographic factors will predict county mask utilization by fitting several statistical models to the proportion of individuals in a county that report always wearing a mask. The best models were selected based on multiple model metrics. The variables that were the most important in predicting county mask utilization by using a model-based variable importance table were examined. Based on the model, the most important predictive variables were the percentage of a county that voted for Joseph Biden in the 2020 Presidential election and the proportion of the county's population born outside the United States.

Alie McEndaffer, '22 — **Fort Collins, CO**
Chemistry — *Sponsor: Craig Teague*

Vibrational Spectroscopy of Redox Active Molecules

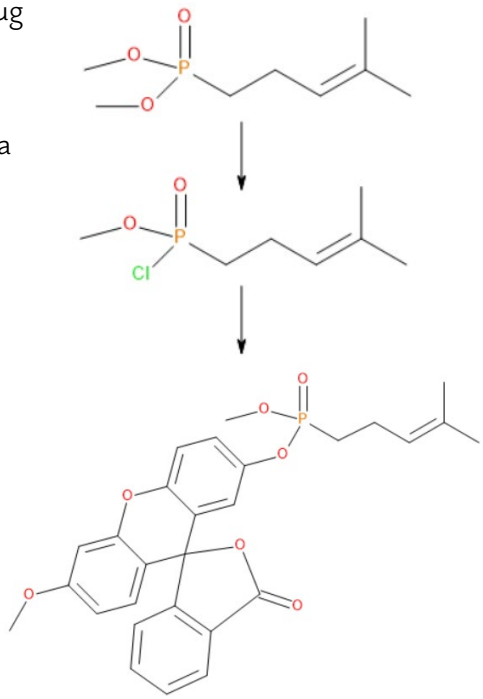
The energy generation system in the U.S. is inefficient. We need to improve energy storage and find new electrical storage systems for renewable energy. On one half of a redox-flow battery there is an electron-accepting compound, while the other has an electron-donating compound. During electron transfer between these two compounds a current will be generated, allowing for the battery to discharge. The reverse of this electron transfer would then charge the battery. We worked with a collaboration, Data-enabled Discovery and Design to Transform Liquid-based Energy Storage (D3TaLES), to investigate solubility properties of chemical compounds that could be used in a redox-flow battery by analyzing peak shifts in vibrational spectra. We used an infrared spectrometer to study the changes in peak position of varying concentrations. Since the systems need to conduct electricity, an electrolyte needs to be added to the solutions in order to increase the current they are able to carry. We used acetonitrile as the solvent to dissolve a solid named 2,2,6,6- tetramethylpoperidin-1-oxyl, or TEMPO. TEMPO is a free radical molecule that can either accept or donate electrons. We made different solutions of varying TEMPO concentrations that ranged from 0.001 mM to 1 M and investigated if there were any peak shifts. Some peaks shifted but only by a few wavenumber. However, these small shifts showed that there were intermolecular force interactions between TEMPO and acetonitrile. The next steps would be continuing the work with TEMPO and also exploring other solution-based redox systems.

Erin McNamer, '22 **Roseville, MN**
Biochemistry & Molecular Biology *Sponsor: Daniel Goetz*

Organophosphorus Medicinal Chemistry: Turn On Fluorescent Prodrugs

Prodrugs are inactive molecules that become active post-administration (in vivo), often used to overcome barriers active molecules would otherwise have, like increased selectivity, solubility, stability, and reduced side effects. Their activation requires a chemical or enzymatic transformation to release the active drug, simultaneously releasing the promoiety. A promoiety is a functional group that is used to change the structure and increase the delivery of the drug. The choice of which promoiety to use is dependent on the prodrug's purpose.

We have started synthesizing a prodrug that turns fluorescent when activated, which could determine the rate and cellular location of the activation process. This is a commonly used approach in molecular biology and drug design to study the kinetics of activation. Outside of the cell, the fluorescent moiety is attached to the inactive prodrug, which turns off any fluorescence. Inside of the cell, the fluorescent moiety "leaves" the prodrug activating the drug and turning on the fluorescence. Each step in our synthesizing process included purification and verification steps, like washing, in vacuo concentration, silica gel chromatography, and 1H, 13C, and 31P NMR. We have successfully completed the reactions in Scheme 1.



Scheme 1 Synthesis of intermediate.

The success of this reaction was the product of a long optimization study involving considerations of solvent choice and synthetic strategy. We rearranged the synthetic sequence of reactions, because we hypothesized that the functional groups on the other part of the prodrug were preventing the fluorescent moiety from attaching. So, we attached the fluorescent moiety first. The molecule we made was not fluorescent, indicating the fluorescent moiety and prodrug were attached. This indicates the potential for furthering this synthetic sequence.

Alina Moore, '22 **Taos, NM**
Biology *Sponsor: Tammy Mildenstein*

The Art of Handling Raptors

Birds of prey are important creatures within the environment. Birds of prey play an important role in maintaining the environmental health of their habitats. They control prey populations by removing the old, sick, or weak animals, keeping these species under control. This can be very helpful in farming areas, such as Iowa. If a bird of prey is not able to be released into the wild, they are given a forever home. A common cause for a bird of prey to not be able to be released is being human imprinted. This happens a lot when a human tries to help a bird of prey at a young age. People find raptors at the base of trees caused by falling out of the nest. When humans touch these birds and help them, the birds revert to relying on humans for everything, imprinting on the human. Depending on how long a raptor is human imprinted, it can lose the ability to fend for itself and live on its own. Raptor centers help these birds of prey have a better chance of living than they could in the wild. To make the life of the raptors interesting, the birds are handled and presented at educational programs. Many birds of prey are captive-bred and used for research along with public outreach through education. Captive-bred raptors are the easiest to train because they are fully human imprinted, allowing the handlers to train the birds to sit on the glove properly. It is important to have a good relationship with the birds of prey so there is trust, otherwise the bird will not behave and the bird or the handler could get seriously injured. Educational programs are important because they further allow the birds to get used to people and they bring awareness to the public about birds of prey. I spent three months handling different species of birds of prey ranging from an American Kestrel to the Great Horned Owl. I tracked my progress with handling the birds of prey each day. There is a huge difference in the ability to handle each kind of bird, and it takes time to truly feel confident in handling different kinds of birds. I am still learning more about handling birds of prey every time I work with them. I would like to continue learning how to handle different species of raptors by continuing to work with them at the Iowa Raptor Project this summer, and hopefully longer. Working with birds of prey has given me a passion for working with them, but the field is extremely competitive. My career goal is to be able to continue working with these birds without becoming a falconer. Being a falconer is expensive and I do not support using these animals to hunt.

Madalyn Morris, '23 — **Ottumwa, IA**
Avelene Schesser, '23 — **Littleton, CO**
Biology — *Sponsor: Craig Tepper*

Photosynthetic Symbionts (*Symbiodinium*) in a Photonegative Snail: How Is that Supposed to Work?

Photonegative marine snails of the genus *Nerita*, collected in San Salvador, The Bahamas, were utilized to investigate whether they contained photosynthetic symbiotic algae of the genus *Symbiodinium*. Nerites are common photonegative snails that are typically located in the intertidal zones and are abundant in the Caribbean. Nerites are represented by three species in San Salvador: *Nerita versicolor* (four tooth), *N. peloranta* (bleeding tooth) and *N. tessellata* (checkered). Our work is based on the findings of Banaszak et al. (2013), who reported that acquisition of *Symbiodinium* at the translucent veliger larval stage significantly enhanced survival and larval growth of *Strombus gigas* (queen conch snail). They demonstrated that the larva's enhanced growth and survival rate was due to its ability to utilize the photosynthetic products produced by the symbiotic algae. They also reported the presence of the symbiote in adult queen conch tissue, but postulated that the symbiote had switched from an autotrophic (photosynthetic) to a parasitic lifestyle in the shelled gastropod.

The object of our research was to determine if the symbiotic relationship found between conch and photosynthetic algae could also be found in nerite snails. Quantitative polymerase chain reaction (qPCR) showed that *Symbiodinium* were present in DNA isolated from adult nerite tissue. Our next step was to isolate total RNA, synthesize complementary DNA (cDNA), and run qPCR to ascertain whether *Symbiodinium* were expressing photosynthetic-specific genes within the shelled snail.

The results have been mixed, with some evidence suggesting that *Symbiodinium* may be expressing photosynthetic-specific genes in the nerite tissue and some evidence that refutes the hypothesis. Further research is needed to determine if *Symbiodinium* are expressing photosynthetic-specific genes in adult nerites.

David Navarro, '22
English & Creative Writing *Sponsor: Kirilka (Katy) Stavreva*

An Enquiry into the Motivations Behind the Initial Government Funding of a Police Force

In 1751, an English magistrate named Henry Fielding published a treatise examining crime in London. The 200-page pamphlet, titled *An Enquiry into the Causes of the Late Increase of Robbers &c*, is a comprehensive analysis of the state of laws and law enforcement relating to crime and the poor in England. In it, Fielding lays out the past and current states of those affairs and makes arguments about the morality and practicality of positions which the contemporary law and those responsible for enforcing it have or haven't taken. Fielding was originally a dramatist and author, but he had moved on to law and was asked to be a magistrate in 1748. He wrote the *Enquiry* to gain support and government funding for his new initiative, a group known as "The Bow Street Runners," which are now called the first iteration of a modern western police force. Modern practices such as the presence of police officers as witnesses during trials and horse-mounted (mobile) police patrols can be traced directly back to the group. Fielding successfully secured funding for his group after the *Enquiry* was published, and Henry (and later his brother John) went on to publish several more proposals about law enforcement and the handling of the poor. This presentation will explore the arguments which would have convinced the government to grant funding to the Fieldings. The points and arguments Fielding brought up remain largely relevant to modern-day policing and understandings of crime, so exploring them gives us an important window into both the past and present states of law enforcement and its relationship to the poor. This presentation will not have a bias for or against police funding. Attendees will walk away from the presentation more informed about the arguments which established police funding and the attitudes of the men who proposed it.

Gwen Paule, '23 — **St. Paul, MN**
Robyn Luchesi, '21 — **Chicago, IL**
Madalyn Morris, 23 — **Ottumwa, IA**
Chemistry and Mathematics & Statistics — *Sponsor: Brandi Shanata and Jai Shanata*

Using Data to Fight a Pandemic Locally: Development and Use of COVID-19 Metrics Development and Use of Metric-Based COVID-19 Data Reports: Change In Perspective

With the onset of the COVID-19 pandemic, all Cornell College students were sent home in March of 2020, abruptly shifting our community from a residential liberal arts setting to entirely remote learning and living. Data to guide decisions regarding safe campus repopulation, depopulation, in-person learning, and community restrictions was needed to safely study and teach on campus again. Seeing this need to analyze high quality and historical data, in a matter of days, the student authors shifted from biochemical lab work to remote collaboration with mentorship from a chemist and a statistician to review, parse, and compile available public health data. Additionally, we contacted data sources and health professionals to further clarify and gain knowledge on COVID-19 data. We created a database, updated nightly for the first fourteen months and weekly from Fall 2021 through February 16, 2022, to characterize the local spread of the disease, use of medical resources, and severity of COVID-19. Collaborating with campus administrators, county/state public health officials, and the campus health center, we devised and curated original metrics to form an accurate, customized view of the pandemic. Each week since Fall 2020, we produced accessible graphs, tables, and reports for the campus population and administration, outlining the current state of the pandemic on the local, state, and national level. The customized collection and usage of COVID-19 data enabled Cornell College to make data-driven decisions concerning learning modality. Cornell College has had largely in-person courses with limited to no classroom transmission in the 2021-2022 school year guided by the collaboration and direction of our own community-led public health infrastructure. As of the end of February 2022, on-campus testing and tracking of the disease identified a cumulative 107 cases out of a student, staff, and faculty population of over 1600, culminating in a 6.67% occurrence rate; less than a third of the U.S. national rate of 23%. This two year-long project influenced a wide-spread, transformative community experience through improving data collection, analysis, and communication. Together we have helped maintain campus safety by building our own public health initiative that has fostered meaningful relationships when they were needed most.

Marcus Quirk, '22 **Edinburgh, Scotland**
Mathematics & Statistics *Sponsor: Jim Freeman*

Improving Travel Efficiency in Sports Leagues Using a Conference-and-Division Model

The travel efficiency of sporting competitions around the world can be improved by applying the conference-and-division model of North American leagues using an efficient algorithmic approach. Conferences and divisions are geographic groupings of teams within a league such that teams play more games against opponents that are nearby than those that are far away. In this paper, we expand on an algorithm outlined by Macdonald and Pulleybank (2013) to minimise league travel from many possible generated groupings for a selection of leagues around the world: the British Basketball League, the EuroLeague, and the English Football League Championship. To find the provably-optimal grouping is considered to be NP-hard, meaning that the problem cannot be solved in a reasonable time frame. However, the algorithm presented can generate many close-to-optimal groupings in just a few minutes, all of which improve travel efficiency compared to the leagues' current formats. Generating multiple groupings permits leagues to choose one that takes into consideration other important factors while still improving travel efficiency, such as exact schedules, actual travel methods, and preserving existing rivalries.

Connor Rittner, '22 **Los Alamos, NM**
Chemistry *Sponsor: Charley Liberko*

Synthesis of an Array of Novel Solvatochromic Dyes

Merocyanine dyes, such as MOED, are well known for their distinct solvatochromic characteristics, which means they change colors in solvents of different polarities. These characteristics are caused by a split charge on each end of the activated molecule, which are stabilized to varying degrees by the solvent they are dissolved in, resulting in different colorations. Many MOED derivatives have a basic pKa of about 8 and need a base to be added to activate their solvatochromic properties, which is costly in both time and resources. The effects of micelles on solvatochromic dyes has been studied, but the way that they interact with the dyes is not yet known.

The purpose of this experiment was to help mitigate the issue of the high pKa of these dyes by making a variety of new dye analogs with substituent groups to affect the pKa and micelle affinities of the dyes. The first batch of new dyes added a bromine (electron withdrawing) group to increase acidity. The second batch added a longer (butyl) carbon chain to the positively charged end of the dye molecule, to allow for use in tests with micelles. The third was a batch of diazo dyes, which

have nitrogens in place of the ring-connecting carbons in MOED. This change had been previously shown to reverse the direction of color change through solvatochromism that was seen in MOED.

Using NMR spectroscopy, analysis of the isolated dyes demonstrated that the first two batches were successfully generated, but the batch of diazo dyes was unsuccessful. The dyes were then tested for their pH and solvent polarity sensitivity, and each successfully generated batch of dyes was sensitive to changes in pH. The brominated dyes had a lower pKa than the non-brominated parent molecules, and unexpectedly, one of the four butylated dyes also had a decreased pKa. The solvatochromism was then measured in each dye, and the first two batches of dyes were determined to have kept their solvatochromism, while the nitrogen-chained dyes did not.

Keegan Schultschik, '22 **Cedar Rapids, IA**
Biochemistry & Molecular Biology *Sponsor: Charley Liberko*

Sulfide Modification of Woody Plant Materials for the Extraction of Pb2+ and Ni2+ Ions from Wastewater

Safe drinking water is a huge, rising issue because not only is it essential for human health but also for the environment. Heavy metal ions are one contaminant that can be harmful and deadly. These heavy metal ions include lead, copper, nickel, iron, cadmium, and others. The removal of these metal ions using instruments is very expensive and difficult to do in rural areas where power is not available. The goal of this project is to find an inexpensive, efficient way to remove heavy metal ions from water that is easy to do in rural areas and can be done with an adsorbent that can be found worldwide. Different chemical pretreatments were applied to the woody plant materials to help improve the metal ion removal. Test strips were developed to measure the metal ion concentrations. The sodium sulfide-treated black tea was the best material for removing lead ions, followed by the sodium sulfide-treated brown rot wood then sodium sulfide-treated white rot wood. The best material for removing the nickel ions was the sodium sulfide-treated brown rot wood followed by the sodium sulfide-treated black tea. The sodium sulfide-treated filter paper shows great potential for a flow through filtration system because of how fast the metal ions are removed from the solution compared to the other materials. Further research should continue to test the sodium sulfide-treated black tea and filter paper and its ability to remove heavy metal ions from water.

Mansour Sims, '24 **Miami, FL**
Computer Science *Sponsor: Ajit Chavan*

Server Clusters: Cornell's Usage Patterns and Trends

Server clustering is a crucial element of high performance computing, and is widely used to support the computational needs of different research fields within the sciences.The nodes of a cluster can be upgraded when more computing power is needed without affecting the server's integrity and work can be transferred between servers, reducing downtime and outages.Users are able to readily access server-related materials at any time because the work will be uninterrupted. In a cluster environment, profiling resource utilization is crucial as it provides a better assessment of returns on investments and helps estimate future needs (capacity planning).

Cornell College has its own server cluster. I used Nagios and Graphite tools to monitor the availability and resource utilization for the servers during Algorithms and Data Structures (CSC 301) in Block 7 and then in Block 8 for Statistical Learning (STA 355). The poster presents our findings regarding memory, CPU, and network utilization. Over the course of two weeks, the software analyzed the usage of the server by returning, compiling, and visualizing the data. These data will be useful in analyzing Cornell's server usage and managing the cluster in the future. The monitoring will not only reveal the usage patterns, downtime, and peaks in usage, but it will also help us plan for the resources needed to support multiple classes at a time.

Sydney Swift, '22 **Aurora, CO**
Keva Tomas, '23 **North Aurora, IL**
Chemistry *Sponsor: Cindy Strong*

Determining Sugar Composition of Fruit Consumed by *Pteropus mariannus* via Quantitative Methods

Pteropus mariannus, also known as the Mariana fruit bat, is a threatened species that is located on the Northern Mariana Islands. This species of frugivore is known to help disperse seeds and pollinate the plants around them. There is currently a reforestation project to help stabilize the threatened bat population. Our goal was to develop a reproducible method that quantifies carbohydrates in fruit. We aim to provide information about the carbohydrate concentration in fruit in order to gain a better understanding of the overall nutritional components and which fruits are most beneficial for the bats' diet. For this analysis, we utilized quantitative nuclear magnetic resonance spectrometry (qNMR) to measure the individual concentrations of sucrose, glucose, and fructose using water suppression. Additionally, an anthrone assay method was used to

measure total soluble carbohydrates. We were able to successfully develop reproducible methods for quantifying individual sugars and total soluble carbohydrates in Rota fruit. Using these methods, we will be able to provide important nutritional information that can be compared across the rest of the Rota fruit samples. Our results will be beneficial to other researchers interested in the conservation efforts of the Mariana fruit bat.

Amy Talman, '22 **Chicago, IL**

Art & Art History *Sponsor: Chris Morris Penn-Goetsch*

Artemisia Gentileschi's Self-Portrait: An Artist in the Making

Artemisia Gentileschi was an artist active during the seventeenth century. Art historian Mary Garrard first argued that her works were significant for their portrayals of women as active agents rather than passive objects in her *Artemisia Gentileschi: The Image of the Female Hero in Italian Baroque Art* of 1989. Artemisia's paintings had feminist tones that made them stand out significantly when compared to that of her male peers. One of the artist's most provocative works is *Self-Portrait as the Allegory of Painting* from 1638. Garrard points out that the artist boldly portrays herself to be the personification of painting here. However, is this work a self -portrait or simply a portrait? I am not the first to consider this question, as Letizia Treves does so in the 2020 catalog for the "Artemisia" exhibition at London's National Gallery. Treves sees the work as both allegory and self-portrait.

The perception of *Self-Portrait as the Allegory of Painting* changes when viewing the work primarily as an allegorical subject, rather than a self-portrait. By comparing *Self-Portrait as the Allegory of Painting* to her own self-portraits and similar works done by others, such as Paul Bril and Nicolas Régnier, we can come to a greater understanding of the possible intentions behind the painting. These intentions are confirmed by the psychology behind early modern self-portraiture as described in the work of W. Ray Crozier and Paul Greenhalgh (1988). Artemisia was only employing her likeness as means to promote herself.

Frank Vega Velazquez, '22 **West Palm Beach, FL**
Biochemistry & Molecular Biology *Sponsor: Catherine Volle*

Effects of Antibiotic Agents in Gram-Positive and Gram-Negative Bacteria

The discovery of antibiotics was one of the most significant medical advances of the 20th century. Many infectious diseases that were once death sentences have been successfully treated with antibiotics. Unfortunately, the rate at which new forms of antimicrobial agents are being discovered has been slow compared to the rapid evolution of antibiotic-resistant pathogens. Antibiotic-resistant bacteria have become a major global healthcare crisis in the 21st century due to a rise in multidrug-resistance pathogens, and they are one of the main reasons the scientific community is trying to design novel classes of antibiotics or discover new drug combinations.

Gram-positive and Gram-negative bacteria have several differences, but the cell wall is the most noticeable. Gram-positives have a thick peptidoglycan cell wall compared to the peptidoglycan layer of Gram-negatives. Gram-negative bacteria have an outer membrane, containing lipopolysaccharide, which is chemically distinct from the cell membrane and makes drug design difficult because most antibiotics need to pass through it to kill the bacteria.

Our research focused on testing antibiotics in different bacteria to see if a correlation exists between how sensitive bacteria are to certain antibiotics and their physical structure. We tested the sensitivity of bacteria to antibiotics by determining the minimum inhibitory concentration (MICs), which is the minimum concentration of antimicrobial agents that will inhibit the visible growth of bacteria.

We expected Gram-negative bacteria to be less susceptible to antibiotics than Gram-positive due to the protective outer membrane. However, our results do not show a significant difference between these two groups or a correlation between how sensitive bacteria are to certain antibiotics and their outer surface. This presentation will show the results for the different bacteria and antibiotic agents and suggestions for future experiments.

Randy Young, '23 **Hilbert, WI**
Chemistry *Sponsor: Charley Liberko*

The Use of Solvatochromic Dyes for the Exploration of the Structures of Micelles

Surfactants are molecules characterized by their polar head groups and long nonpolar tails. When in a great enough concentration, surfactants aggregate to form orb-like complexes known as micelles. The concentration of surfactant molecules at which micelles begin to form is known as the critical micelle concentration (CMC). When these molecules are in polar solvents, such as water, their polar head groups are on the outer surface of the micelle, and when in an organic solvent, such as hexane or diethyl ether, the long nonpolar tails make up the exterior of the micelle. This means that micelles are polar and nonpolar simultaneously in their own separate regions. The two surfactants focused on for quantitative research were Sodium Dodecyl Sulfate (SDS) and Cetyltrimethylammonium Bromide (CTAB).

The goal of my research was to further understand both types of micelles, as well as their interactions with merocyanine dye analogs, and quantitative research focused on an analog that we have coined as MOEL (1-Methyl-4[(oxocyclohexadienylidene)-Ethylidene]-1,4-Dihydrolepidine). Due to MOEL's highly reactive color change caused by factors such as temperature, pH, and solvent polarity, it was deemed as worthwhile to further investigate the behavior of the dye when in solution with surfactants both above and below the CMC. Characteristics investigated included pKa shifts in the dye molecule, changes in dye behavior by changing the concentration of surfactant used, heating and cooling of the solution to test for color change and calculating the equilibrium constant for the inclusion of the dye into the micelle. UV-Vis spectra of MOEL in CTAB showed an isosbestic point around 530 nm, and equilibrium constant calculations showed that the constants for MOEL in CTAB and MOEL in SDS had different values.

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Using CRISPR/Cas9 to Investigate grhl3 in Zebrafish

Cleft lip and cleft palate are developmental disorders characterized by a deficit in fusion between the right and left halves of the upper lip, palate, or both. Several genes control the development of the lip and palate, and their loss or mutation have been implicated in causing cleft lip and/or palate. Genome-wide association studies have implicated the gene (grhl3) for the protein Grainyhead-like 3 might play a key role in development of this area. Non-primate models are routinely used to

identify and characterize the roles of specific genes in these developmental disorders. Foremost among these is the zebrafish, *Danio rerio*. Unfortunately, maintaining lines of zebrafish with deletion of grhl3 is difficult. Heterozygotes must be maintained, and it is difficult to determine whether or not a fish is a heterozygote since there is no indication of a developmental deficit. Therefore, I wanted to design a way to determine whether or not a fish carried a mutation in grhl3. My goal was to design a plasmid that would insert into grhl3 and also carry a fluorescent protein that would easily identify whether or not a heterozygous fish carried the mutated gene. I designed the plasmid using CRISPR-Cas9 and injected the plasmid into fertilized zebrafish eggs. I had to check whether or not the designed plasmid carried both the grhl3 insertion and the fluorescent gene by sequencing.

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The Pre-Raphaelite Pandora

In his book, *Victorian Culture and Classical Antiquity*, Simon Goldhill discusses John William Waterhouse's works and makes fascinating points about how the artist manipulates the viewer's perception. One particular observation about Waterhouse's *Mariamne* (1887) stands out; he claims that the allure of a femme fatale places the viewer in the same position as her victims. If a man's fatal mistake is falling for the allure of the femme fatale, is the viewer any different now that they have fallen for her as well? I argue that Goldhill's commentary is even better applied to one subject depicted by Dante Gabriel Rossetti, *Pandora*.

Artistic depictions of Pandora, particularly that of Rossetti, express this by interrogating the viewer's perception of her. This direct challenge to the viewer makes Rossetti's works unique among other Pre-Raphaelite depictions of Pandora; this interaction is much more personal, both to its general audience and to the artist himself. By being enraptured by Pandora's beauty, is the viewer not guilty of the same sin that Epimetheus was? Her beauty is both a gift and a curse; even the accompanying poem discusses this, asking if it was really the actions of Pandora herself that were to blame or the gifts of physical beauty that the gods had given her. Rossetti's Pandora, whose daring gaze acknowledges and implicates the viewer, is characteristic of Goldhill's commentary. Many images of Pandora from the Pre-Raphaelite movement interrogate the viewer in a way that fits with Goldhill's ideas, but none so directly or poignantly as Rossetti's.

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