# PROGRAM SCHEDULE WITH ABSTRACTS

## APRIL 26, 2019
## University of Mary Washington
Fredericksburg, Virginia

Financial Support for Research and Creativity Day generously provided by the Class of 1959 Endowment

# Schedule of Events

## April 26, 2019

**Researcher Registration and Poster Set-up**

**8:30 am - 9:30 am in the Hurley Convergence Center (Check-in at Digital Auditorium; Poster Pick-up begins at 4:00 pm)**

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| **Oral Sessions** | **10:00 - 3:00** |
| HCC Classrooms 307, 327, 328 & 329 | |
| **Poster Sessions** | **12:00– 1:15** |
| HCC Building Locations | *refreshments served for all* |
| **Original Music Performances** | **1:30 - 2:30** |
| Digital Auditorium HCC | |

**Additional Exhibits and Sessions**

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|---|---|
| HCC Convergence Gallery (Margaret Sutton: Face to Face) | **9:00 – 4:00** |
| Phyllis Ridderhof Martin Gallery (Art History) | **3:00 – 4:00** |
| Trinkle Hall (College of Education) | **12:00 – 12:50** |
| Trinkle Hall (Computer Science) | **12:00 – 5:00** |
| Combs Hall (Kemp Symposium) | **9:00 – 4:00** |
| University Center (Studio Art) | **9:00 – 7:00** |
| Monroe Hall (Geography) | **9:00 – 4:00** |
| Heslep Amphitheatre (Classics) | **4:00 – 5:00** |

# Exhibits in Hurley Convergence Center

**9:00 – 4:00**

**Convergence Gallery (Third floor)**

## …what the mind and senses conceive… Margaret Sutton

**Prepared by students in Art History 317: Laboratory in Museum Studies**

Kira Alfano, Krista Beucler, Laurel Davidson, Anna Elmore, Shaheen Fazel, Gabby Gallier, Matthew Geczy, Bucky Goforth, Paige Hildebrand, Meggie Hinson, Juliet Landeck, R.J. McKenna, Alli Pryor, Jordan Skillman, Hannah St. Onge, Alexa Steele, Cara Wissinger (Dr. Marjorie Och)

# Morning Oral Sessions in Hurley Convergence Center

**10:00 – 11:00**

**Room 327**

**Session Chair: Dr. Leo Lee (Mathematics)**

Brandon Rozek, "QEP: The Q-Value Policy Evaluation Algorithm" (Dr. Ron Zacharski)

Hannah Killian, "Effect of Oxide Layer Thickness on Tunneling-Percolation Threshold in Nanoparticle-Polymer Composites" (Dr. George King)

Emily MacIndoe, "Analysis of Deterministic and Stochastic HIV Models" (Dr. Leo Lee)

Corinne Rydgren and Benjamin Ahrens, "Concepts of Surfaces and their Applications Using Mathematics" (Dr. Jen Chiang)

## 10:00 – 11:00

### Room 329

**Session Chair: Dr. Emily Stanley (Psychological Science)**

Emily Knerr, "Using Financial Data to Measure Effects of a Changing Economy: A Study of Homeless Shelters" (Mr. Ken Machande)

Kelsey Burham, "Supply and Demand: Understanding Continued Opioid Drug Trade between Latin America and the United States" (Drs. Chad Murphy and Robert Barr)

Lilly Fawcett, "An Anthropological Study of American Girl Dolls" (Dr. Jason James)

Rachael Friedenberg, "The Many Features Women Want: The Design and Marketing of Houses towards Women at the Turn of the Twentieth Century" (Dr. Christine Henry)

## 11:00 – 12:00

### Room 327

**Session Chair: Dr. Janet Asper (Chemistry)**

Kathleen Elliott, "The Seasonality of Oxygen and Hydrogen Isotopes of Rain, Stream and Groundwater in Fredericksburg, VA" (Dr. Pamela Grothe)

Cat Zwemer, "The Temporal Dynamics of the Caspase-8 activation in the Extrinsic Process of Apoptosis" (Dr. Randall Reif)

John Pruchnic, Steve Berrios and Zachary Zwierko, "Chemical Equilibrium Visualization" (Dr. Ray Scott)

Katie Hartraft, Chris Ringham and Mandy Byrd, "Domain Fellows: A Student Cohort about Domain of One's Own" (Ms. Martha Burtis)

### Room 328

**Session Chair: Dr. Stephen Farnsworth (Political Science)**

Mackenzie Poust, "A Woman's Place: The Role of Women within Fundamentalist Interpretations of Islam and the Discourse on Autonomy" (Dr. Farhang Rouhani)

Hannah Rothwell, "Analysis of Media Language in Arabic and English News Coverage" (Ms. Maysoon Ahmed Al-Sayed)

John Cronin, "The 'Will of the Voters': Examining Legislative Repeal of State Ballot Initiatives" (Dr. Stephen Farnsworth)

Haley Randall, "Virginia Women and Politics: Party-Line Voting Patterns in the 2016 Presidential Election" (Dr. Stephen Farnsworth)

**11:00 – 12:00**

**Room 329**

**Session Chair: Dr. Josephine Antwi (Biological Sciences)**

Andrew LaMarca, "Rationality and Decision Making in the Origins of Mediterranean Commerce" (Dr. Don Lee)

Cecelia Burkett, "Trends and Effects of Advertising Legal Addictive Substances in the United States" (Dr. Lance Gentry)

Elyse Ridder, "Pirating HMS Pinafore: Sousa's 1879 Orchestration" (Dr. Brooks Kuykendall)

Ilana Bleich, McKinley Groves, Amy Guzulaitis, Paige McLachlan, and Rachel Thayer, "Waste Management in Fredericksburg, Virginia" (Dr. Andrea Smith)

# Poster Sessions – Hurley Convergence Center

## 12:00 – 1:15

- Will Albritton, Carina Martin, Autumn Flemming, Morgan Noland, Nicklaus Wohler, "Determining the Physiological Effect of Unstable Environment on Anxiety Behaviors and CRH Receptor Density in Mice" (Dr. Parrish Waters)
- Chris Amurrio, "Optimizing the Kinetic Enzymatic Resolution of 2-Ethyl-1-Hexanol" (Dr. Davis Oldham)
- Igor Asipenka, "Identifying Phishing with Interactive Methods" (Dr. Andrew Marshall)
- Aminata Bangura and Josie Jerge, "Effect of phosphorus on root hair number in the Arabidopsis thaliana mutant Axr2-1" (Dr. April Wynn)
- Rachel Bellamy, "Multivariate Analysis for Malaria Prevalence in Ghana" (Dr. Marco Millones-Mayer)
- Arnita Best, "Teaching Coding to School-Age Students" (Dr. George Meadows)
- Olivia Blake, "Dopamine Receptor Expression in Worker Honey Bees in Response to Queen Mandibular Pheromone" (Dr. Deborah O'Dell)

- Robert Byles, "Quantifying Ecosystem Services of Landscaped Trees and Woodlots on the University of Mary Washington Campus" (Dr. Alan Griffith)
- Mandy Byrd, Cindy Ly, and Garrett O'Donnell, "Analysis of Environmental Performance by Region and Income" (Drs. Debra Hydorn and Melody Denhere)
- Emily Contompasis and Abbi Conklin, "MWCF Herbarium Digitization: Plant Preservation in the Age of Technology" (Dr. April Wynn)
- Reed Cornwell, Jillian Stone, and Andrea Abell, "Quantification of Free Chlorine Residue on PVC Pipes By Uv-Vis Spectroscopy" (Dr. Randall Reif)
- Peyton Crickman, "Perfectionism as it relates to Error Related Brain Activity" (Dr. Emily Stanley)
- Damon Dixon, "Quantifying Creativity with Facebook Marketing" (Dr. Kashef Majid)
- Thanh-Binh Duong, "Microplastics: Presence, concentrations, and influence on toxicity of methoxychlor to Daphnia *magna*" (Drs. Tyler Frankel and Ben Kisila)
- Isabel Faust, Allison Burgess and Riley Manthey, "Analysis of Drinking Water Quality in Buildings at the University of Mary Washington" (Dr. Melanie Szulczewski)
- Stacey Feindt, "Detained by Data: A Critical Analysis of the Virginia Pretrial Risk Assessment Instrument" (Dr. Rosalyn Cooperman)
- Sara Fioretti, "Combined Effects of Chemotherapeutic Agents and Statins on HNSCC" (Dr. Rosemary Barra)
- Takesha Foster and Stephanie Weigert, "The Effect of Partial Sleep Deprivation on Long-term Memory and Anxiety in Mice" (Dr. Parrish Waters)
- Jackson R. Gardner, "Preferential Responses of Young Rats to Palatable Food vs. Social Play" (Dr. Parrish Waters)
- Josephine Gray and Carmen Martinez, "Assessing differences in drought stress response between an heirloom tomato cultivar, *Blue Beech*, and a large-fruit tomato cultivar, *Bigdena*" (Dr. April Wynn)
- Rachel Gunraj, "IR Analysis of Microplastics" (Dr. Janet Asper)
- Shivani Gupta, "Optical Trapping of Nanoparticles" (Dr. Maia Magrakvelidze)
- Logan Hargis, "Transgenic Arabidopsis" (Dr. April Wynn)
- Sterling Heyns, "Virtual Solenoid Project" (Dr. Maia Magrakvelidze)
- Mary Hoffman, "Sublethal Effects of Sulfoxaflor on Behavior and Physiology of Daphnia *magna*" (Dr. Tyler Frankel)
- Lindsey Jones and Erin Schaeffer, "Kinetic isotope effect: Determining the mechanism of the rate determining step of the oxidation of 1-phenylethanol to acetophenone" (Dr. Leanna Giancarlo)
- Kelly Keane and Marissa Howard, "The Effect of Clothianidin on the Ability of Crayfish to Respond to Food Odor" (Dr. Abbie Tomba)
- Hannah Killian and Melissa Pampel, "Evaluating the Transition States of the Wittig Reaction Mechanisms by Molecular Modeling" (Dr. Leanna Giancarlo)

- Juliana Kolba, "Magnolias of Virginia: Magnolia *grandiflora* and Magnolia *virginiana*" (Dr. April Wynn)
- Justin Kramp, Alex Ramirez-G'Arce and Austin Williams, "Quantitative Analysis of Arsenic and Selenium pollution in the Potomac River from Power Plants by UV-Vis spectroscopy and verification by ICP-AES" (Dr. Randall Reif)
- Haley Lavach, Haley Garcia, Laura Leonard and Sarah Piper, "Analysis of BDNF Expression in the Hippocampus; How Diet and Exercise Affect Spatial Memory and Learning in Mice" (Dr. Parrish Waters)
- Rachel Mattozzi, "Characterizing Novel Escherichia *coli* Mutants" (Dr. April Wynn)
- Cayley McGuire and Gemma Spicka-Proffit, "An Investigation on the Correlation Between Dwarfism and Drought Resistance in Arabidopsis *thaliana* plants" (Dr. April Wynn)
- Phillip McNeil, "The identification of ecological function values of native and non-native tree species on University of Mary Washington Campus using i-Tree eco V6" (Dr. Alan Griffith)
- Andrea L. Moore, "Constraining the Mid-Holocene ENSO Minimum in the Central Pacific Using Geochemistry of a 5,000-year-old Porites Fossil Coral" (Dr. Pamela Grothe)
- Joshua Morris, Chloe Morton and Colin Travis, "Growth Kinetics of Zinc Oxide Nanoparticles for Use in Sunscreen" (Dr. Leanna Giancarlo)
- Lisa Mosser and Katherine Sweeney, "A policy-capturing approach to individuals' decision to accept job offers: The role of support and demographic differences" (Dr. Alexandra Dunn)
- Joshua Olbert, "Heat Loss of UMW Buildings" (Dr. Chuck Whipkey)
- Cheyenne Palmo, "Survey of Paired δ18O, δD and Salinity for the Chesapeake Bay and its Major Tributaries: Applications to Regional Paleohydrology" (Dr. Pamela Grothe)
- Kaitlyn Parker, "Design and Synthesis of Indazole Sulfonamides as Inhibitors of KasA: A New Approach to Tuberculosis Infection" (Dr. Davis Oldham)
- Ashley Parkhurst and Emily Matuczinski, "Mapping the ultramorphological changes of SPION-induced cell death in Glioblastoma Multiforme" (Dr. Leanna Giancarlo)
- Brighton Payne, "The Relationship Between Latent Inhibition, Dopamine, and Creativity" (Drs. Hilary Stebbins and W. David Stahlman)
- Abigail Phelps, "Keeping the Tune: Jaw Harps and Colonial Music of the Chesapeake" (Dr. Dr. Lauren McMillan)
- Megan Price, "Client Selection for a Risk-Constrained Commodity Option Underwriter facing Poisson Demand" (Dr. Belleh Fontem)
- Devin Rantz and Sam Mackin, "Belmont Tree Survey" (Dr. Alan Griffith)
- Brynne Reeves and Caitlin Hilland, "Determining the Function of Unknown Polymorphic Alleles in PIN and CHS Genes in Arabidopsis *thaliana*" (Dr. April Wynn)
- Emily Richardson, "Shoreline Preservation on Marlborough Point, Stafford County, Virginia" (Dr. Pamela Grothe)

- Grace Rihl and Daniel Arango, "Sedimentation Rate and Trace Metal Input in Lake Occoquan and Lake Manassas" (Drs. Ben Kisila and Leanna Giancarlo )
- Anna Rinko, "Patterns of Wheel Running in Bulbectomized Mice" (Dr. Parrish Waters)
- Anna Ruuskanen, "Identifying Digenetic Trematodes Infecting Elimia *virginica* snails and Cyprinid fish in Eastern Virginia" (Dr. Abbie Tomba)
- Emily Saldanha, "How the Language of Choice Affects Perceptions of Women in the Workplace" (Dr. Miriam Liss)
- Leonid Smorodintsev-Schiller, "Investigation into the function of Saccharomyces *cerevisiae* YLR149C and SIR2 genes in the presence of hydrogen peroxide and nicotinamide mononucleotide" (Dr. Debbie Zies)
- Gus Schneider, Alliyah Ramos and Chris Amurrio, "Detecting Heavy Metals in Inexpensive Jewelry" (Dr. Randall Reif)
- Arshuman Sheikh and Arham Zahid, "Measuring the effects of food deprivation on leptin levels and social interaction in mice" (Dr. Parrish Waters)
- Rachel Summers, "Embryonic Development of the Stress Hormone Axis in Two Model Teleost Species" (Dr. Dianne Baker)
- Mariam Tekle, "Determining the Role of the Sacchromyces *cerevisiae* Gene, YDL199C, in DNA Repair" (Dr. Debbie Zies)
- Katherine Toomey, "Defining Witchcraft and Spirituality in Modern Society" (Dr. Eric Gable)
- Paola Urlich and Samantha St. John, "The Effect of SC-66 AKT Inhibitor on HCT-116 Colon Cancer Cell Viability" (Dr. Rosemary Barra)
- Zachary Zwierko, "Making ArcGIS Mapping Data Accessible to the Visually Impaired" (Dr. Alan Griffith)

# Original Music Performances – Digital Auditorium

## 1:30 – 2:30

### Participating Students

| | | |
|---|---|---|
| Sam Bradshaw | Drake Dragone | Jack Landers |
| Madyson May | Shawn Mitchell | Emmanuel Smith |
| Shane Thin | Robert Thompson | |

# Afternoon Oral Sessions in Hurley Convergence Center

**1:00 – 2:00**

## Room 327

**Session Chair: Dr. Surupa Gupta (Political Science)**

Grace McCauley, "Who Rules the School" (Dr. Debra Schleef)

Julia Gibbons, "Female Secondary School Stipend Programs in Pakistan and Bangladesh" (Dr. Surupa Gupta)

Mary Skinner, "Dismantling Purity Culture: The Representation of Female Sexuality in the Evangelical American South" (Dr. Kate Haffey)

Ren Koloni, "Neuroqueering Gender" (Dr. Tracy Citeroni)

## Room 329

**Session Chair: Dr. Lauren McMillan (Historic Preservation)**

Will Everett, "The Sacred Fire of Nationality: Irish Public Opinion of Irish Nationalism in the Wake of the Easter Rising of 1916" (Dr. Claudine Ferrell)"

Olivia Larson, "Debitage Analysis: Burlington County, New Jersey" (Dr. Lauren McMillan)

Delaney Resweber, "Stratford Hall Plantation: An Analysis of Yard Space at the West Field and Oval Site" (Dr. Lauren McMillan)

Shannon Bremer, "A Soldier's Words: Literacy and Writing at Sherwood Forest Plantation during the Civil War" (Dr. Lauren McMillan)

## 2:00 – 3:00

### Room 327

**Chemistry Honors Research Presentations**

Lindsey Jones, "Synthesis of piperidinol-based inhibitors of KasA: A novel treatment for Mycobacterium tuberculosis infection" (Dr. Davis Oldham)

Matthew A. Tovar, "Synthesis and Application of a Magnetic Nanoparticle Based Nano-complex for Targeted Cell Death in Glioblastoma Multiforme Cells" (Dr. Leanna Giancarlo)

### Room 328

**Session Chair: Dr. Andrea Smith (Historic Preservation)**

Gary Kellenberger, "Crime, Background Checks, and Politics. The Effect of Firearm Background Checks on Violent Crime" (Dr. Don Lee)

Lexandria Stanford, "Self-Determination: The Korean Independence Movement and the Korean Community in the United States" (Dr. Krystyn Moon)

Hannah Gautsch, "Hearing Silences in Cereus Blooms at Night and Tide Running" (Drs. Kate Haffey and Shumona Dasgupta)

Renee Brittigan, "The Residual: a Novel" (Dr. Warren Rochelle)

### Room 329

**Session Chair: Mr. David Hamon (Political Science)**

Emily Contompasis, "The Effects of Environmental Conditions on Expression of the ETTIN (ETT) Gene in perianthia (pan) Mutant Arabidopsis *thaliana*" (Dr. April Wynn)

Haley Lavach, Haley Garcia, Laura Leonard and Sarah Piper, "Analysis of BDNF Expression in the Hippocampus; How Diet and Exercise Affect Spatial Memory and Learning in Mice" (Dr. Parrish Waters)

Arshuman Sheikh and Arham Zahid, "Measuring the Effects of Food Deprivation on Leptin Levels and Social Interaction in Mice" (Dr. Parrish Waters)

Ethan Knick, "Facing a Mystery: Exploring the Presence of a Lone Native American Anthropomorphic Effigy from a 17th-Century Virginia Plantation" (Dr. Lauren McMillan)

# Session in Phyllis Ridderhof Martin Gallery

**3:00 – 4:00**

### Individual Studies in Art History

Mary Novitsky, "Vincent van Gogh's Self Portraits" (Dr. Suzie Kim)

# Sessions in Trinkle Hall

**12:00 – 5:00**

**Room B6**

### UMW Computer Science Programming Extravaganza

**12:00**

Clare Arrington, "Assessing Bias Removal from Word Embeddings" (Dr. Ron Zacharski)

**Demonstrations of Student Computer Programs**

Stefano Coronado, "Accent Copier"

Zoe Cooper, "Emotion Mining with English and Spanish: Multilingual Natural Language Processing"

Luis Rovira, "Space Sword"

Chad Baxter, "From Russia with Love"

Raymond Kauffman, "Mandelbrot Fractal Explorer"

David Miller, "RFID Music Player"

Michael Corbin, "Survival Video Game made with Unity"

Sandra Shtabnaya and Momal Juda, "Dancing Air Piano"

Kira Itzkoff, "Animal Information System"

Corey Staier, "Meditation in Virtual Reality-Biofeedback and Contemplative Practice in Virtual Environments"

Jessica Patrick, "Pong Game"

**12:00 – 12:50**

**Room 204**

Students enrolled in EDUC 311, "Arts Integration in Action: Creating Content-Focused Children's Books for Local Elementary Classrooms", (Dr. Melissa Wells)

# Sessions in Combs Hall

## William Kemp Symposium

The English, Linguistics, and Communication Department's Fifteenth Annual William Kemp Symposium will take place all day on Thursday, April 25 & Friday, April 26, 2019 in Combs Hall. This symposium will be an opportunity for students who have taken courses in the department to showcase their original research projects and creative work. There will be nearly two-dozen different panels on a wide variety of topics. For a detailed program, stop by the ELC department the week of April 22 (Combs Hall, 3rd floor), or contact the symposium's organizer Professor Kate Haffey (khaffey@umw.edu) for a digital copy. All are welcome!

# University Center

**9:00 – 7:00**

**Chandler Ballroom Foyer**

## The Department of Art and Art History hosts their Annual Student Art Exhibit

**Reception from 5:00 – 7:00 pm on Friday, April 26, 2019**

**Exhibit Dates: April 23 – 28th, 2019**

**Participating Students**

| | | | |
|---|---|---|---|
| Riley Anderson | Brandy Bodolay | Madison Caron | AllyAnne Downs |
| Anika Hussain | Lindsay Innis | Rachel Kirby | Chrystalyne Knapp |
| Samantha McMullen | Kasey Mundy | Eleanor Nielsen | Rachel Nobles |
| Jeff Powell | Emily Siegfried | Taylor Springer | Amber Tranter |

# Monroe Hall

## Geography Symposium

**9:00 - 12:00**

**Room 204**

**9:00**

Marisa Payne & Lilly Lester, "Coastal Erosion in Louisiana"

Darby Libka, "#nolaeats: Marketing New Orleans' French Quarter Restaurants Using Instagram"

### 10:00

Annie Sullivan, "Geography in Education"

Katie Boston, "Community Gardens in Richmond, VA: Their Impact on Community"

### 11:00

Hannah Huggins & Sarah Hampton, "Jaguars along the US Mexico Border"

Richard Lewis, "Gentrifying the Fruit Loop: An oral history of Dupont Circle's Queerspaces"

## 12:00 – 2:00

### Posters Room 319

Brittanie Sadler, "HOLC Maps: An Analysis of Persistent Structural Inequality in Baltimore"

Alex Chrvala, "Extending Interstate 97 to Richmond to Fix Mid-Atlantic Transport Headache"

Owen Donovan, "Temporal Mapping of Green Book Locations in Richmond, Virginia, from 1940 to 1960."

Zachary Goshorn, "Digitizing early 20th century Richmond: Mapping Racial Segregation and Park Access"

John Lenox, "Surface and subsurface water flows at Crow's Nest Natural Area."

Jacob Palmer, "Representing People and Nature along the Rappahannock River."

## 1:30 - 4:00

### Room 204

### 1:30

Sarah Giuseppe, "Picturing Urban 5th Grade"

### 2:00

Natalie Davis & Jacob Palmer, "Bears Ears National Monument: A Reduction of Heritage."

Beth Devine & Jennifer Garrard, "Creating an Accessibility Map of UMW's Campus"

**3:00**

Rachel Bellamy, "Multivariate Analysis for Malaria Prevalence in Ghana" 3 pm

Gillian Snell, "Airbnb in New Orleans: a qualitative analysis of local reactions to the rise of short-term rentals"

# Heslep Amphitheatre

**4:00**

## The *Pseudolus*, by Titus Maccius Plautus (c. 254 - 184 BCE)

Presented by the Roman Drama class (Latin 352A and Classics 492) in Latin, with some narrative assistance in English,

*Boy meets girl, boy loses girl, boy gets girl. A worried father. Some helpful friends. A greedy pimp. Some very clever slaves. In short, the usual Roman comedy. Fun for all, and no one gets hurt (except maybe the greedy pimp). Plautus inspired Shakespeare's comedies and Broadway's "A Funny Thing Happened on the Way to the Forum." See the original!*

Free admission. Open to the public. Questions? Call (540) 654-1023.

| CAST | ROLES |
|---|---|
| Ariane Akhand | Ballio I *Leno (Pimp)* |
| Emma Asbury | Simo *Senex (Old man)* |
| Abigail Brock | Phoenicium *Meretrix (Prostitute)* |
| William Carpenter | Calidorus *Adulescens, (Youth)* & Callipho *Senex (Old man)* |
| Emma Eichenberger | Pseudolus II *Servus (Slave)* |
| Margaret Hinson | Hedylium *Meretrix, (Prostitute)* & Narrator II |
| Matthew Nelson | Pseudolus I *Servus (Slave)* |
| Lauren Rosenberger | Puer II *Servus (Slave)* |
| Lillian Salamone | Simia *Servus (Slave) /Miles (Soldier)* |
| Cayce Walker | Ballio II *Leno (Pimp)* |
| Ruth Wilmot | Harpax *Miles (Soldier), &* Charinus *Adulescens (Youth)* |
| Kalina Zizulka | Puer I *Servus, (Slave)* & Narrator I |

# Abstracts

Listed Alphabetically By Student Researcher

**Student researcher(s): Will Albritton, Carina Martin, Autumn Flemming, Morgan Noland, Nicklaus Wohler**
**Major: Biology**
**Research Mentor(s): Dr. Parrish Waters**
**Project Title: Determining the physiological effect of unstable environment on anxiety behaviors and CRH receptor density in mice**

Mice raised in an enriched environment display lower levels of anxiety than mice raised in impoverished environments (Rogers, 2017). To examine the impact of instability on anxiety levels in mice, we will expose mice to a stable or destabilized enriched environment to understand the potential effect of stability. To understand the physiological effects of this experiment we will measure corticotropin-releasing hormone (CRH) receptor density in the bed nucleus of the stria terminalis (BNST). We will also analyze anxiety levels via approach-avoidance behavior. We will raise 16 male mice in two groups which will be duplicated, for a total of 4 groups. Duplication will ensure that the results of the study are not due to interactions between cage-mates. The control group will have an enriched environment according to IACUC guidelines on mouse enrichment (IACUC). The experimental group will initially be exposed to the same environment as the control group; however, the items composing the enrichment in the experimental environment will be exchanged for different items of enrichment, biweekly. This will create an unstable environment for the mice, which has been found to exhibit strong nesting behavior (Deacon, 2006). Anxious behavior will be quantified using a light-dark box test and an elevated plus maze. Longer amounts of time spent in the dark box versus the light box will indicate increased anxiety. In the elevated plus maze, data will be quantified for the number of entries into open/closed arms, the time spent in open/closed arms and the time spent in the central square. After an 8-week period, the mice will be retrieved from the cage. We will euthanize them in accordance with IACUC guidelines, and density of CRH receptors in the BNST will be determined using a CRH1 ELISA from AVIVA Systems Biology. A standard t-test will be used to interpret any significant differences between the control and experimental groups.

**Student researcher(s): Kira Alfano, Krista Beucler, Laurel Davidson, Anna Elmore, Shaheen Fazel, Gabby Gallier, Matthew Geczy, Bucky Goforth, Paige Hildebrand, Meggie Hinson, Juliet Landeck, R.J. McKenna, Alli Pryor, Jordan Skillman, Hannah St. Onge, Alexa Steele, Cara Wissinger**
**Major: Art History and Museum Studies**
**Research Mentor(s): Dr. Marjorie Och**
**Project Title: …what the mind and senses conceive… Margaret Sutton**

Margaret Sutton, a 1926 graduate of the State Teachers College in Fredericksburg, now the University of Mary Washington, settled in New York City in the early 1930s and immersed herself in the city's dynamic art schools

and gallery scene. After earning her master's in fine arts education from the Teachers College at Columbia University, Sutton studied with Hans Hofmann (1880-1966) first at the Art Students League then in his own school in Greenwich Village.

Most of the works in this exhibition are dated to the 1940s, a decade that witnessed Sutton's continued exploration of cubism and surrealism and her initial forays into abstract expressionism. Sutton's focus on color suggests that Hofmann's teachings were never far from her mind. Indeed, Hofmann's emphasis on color relationships led to her deeper appreciation of the painters Henri Matisse (1869-1954), Wassily Kandinsky (1866-1944), Paul Klee (1879-1940), and Piet Mondrian (1872-1944), whose influences are evident in many of the works shown here.

Throughout her life, Sutton explored Eastern religions and philosophy, theories of art, psychology, and dreams. In an undated note, she wrote "I have never been interested in replicas of what the eye sees but what the mind and senses conceive. They will become the basis for a more perfect and aesthetic form." Whether her attention was focused on the human figure, fantastic landscapes, geometric patterns, or wild animals in nature or at the circus, Sutton never merely represented. Always interpreting, Sutton filtered what was before her through her deep knowledge of the history of art, keen engagement with contemporary practice, and a celebration of human imagination in her pursuit of "a more perfect" art.

**Student researcher(s): Chris J. Amurrio**
**Major: Biochemistry**
**Research Mentor(s): Dr. Davis Oldham**
**Project Title: Optimizing the Kinetic Enzymatic Resolution of 2-Ethyl-1-Hexanol**

Plasticizers such as phthalates are chemicals commonly added to plastics to make them stronger. Studies have revealed that phthalates may be toxic to living organisms, and in humans, phthalates behave as endocrine disruptors. One common phthalate is di(2-ethylhexyl) phthalate (DEHP) which exists in three stereoisomeric forms. Upon ingestion, DEHP is metabolized into mono(2-ethylhexyl) phthalate (MEHP). As the body can be sensitive and selective between chiral molecules, DEHP and MEHP must be synthesized in pure stereoisomeric forms to study their chiral toxicology. The precursor 2-ethyl-1-hexanol is needed to synthesize the phthalates for study. Thus optimization of the chiral resolution of 2-ethyl-1-hexanol is necessary. Esterification of the alcohol via kinetic enzymatic resolution utilizing lipase and succinic anhydride has led to 94% enantiomerically pure (R)-alcohol. The enantiomer (S)-alcohol has been extracted at 84% purity. In an alternative reaction under cold conditions, using vinyl acetate instead of succinic anhydride, the (R)-alcohol has been detected at 99% and the (S)-alcohol at 80% but at a greater completion rate. Additionally, enzymatic hydrolysis of 2-ethylhexyl hemisuccinate at room temperature has seen consistent levels >75% (S)-alcohol over time. Future studies will involve the "re-purification" using substrates already in enantiomeric excess instead of racemic mixtures. Additionally, the optimization of the extractions will be carried out as the chiral purity of the extracted product is typically lower than that of the detected value.

**Student researcher(s): Clare Arrington**
**Major: Computer Science**
**Research Mentor(s): Dr. Ron Zacharski**
**Project Title: Assessing Bias Removal from Word Embeddings**

As machine learning becomes more influential in our everyday life, we must begin addressing potential shortcomings. A current problem area is word embeddings, a group of frameworks that transform words into numbers, allowing the algorithmic analysis of language. Without a method for filtering implicit human bias from the documents used to create these embeddings, they contain and propagate stereotypes. Previous work has shown that one commonly used and distributed vector trained on articles from Google News contained prejudice between gender and occupation. While unsurprising, the use of biased data in machine learning models only serves to amplify the problem further. Although attempts have been made to remove or reduce these biases, a true solution has yet to be found. Hiring models, tools trained to identify well-fitting candidates, show the impact of gender stereotypes on occupations. Companies like Amazon have abandoned these systems before due to flawed decision-making, even after years of development.

I investigated whether the current technique of word embedding adjustments made a difference in the results of an emulated hiring model. After collecting and cleaning a corpus of resumes and job postings, I performed

two machine learning tasks. The first was finding new candidates for a job based on a training set of resumes from those already hired. The second task was sorting a candidate into a specific job category based on language used in job postings from that category. Each task used a set of different word embedding algorithms, including the original and adjusted word2vec embedding. Results are expected to show some form of bias on classification. However, due to the small scale of data used, the extent of present prejudice may be difficult to identify.

**Student researcher(s): Igor Asipenka**
**Major: Computer Science**
**Research Mentor(s): Dr. Andrew Marshall**
**Project Title: Identifying Phishing with Interactive Methods**

The problem I have analyzed and studied in my research is the ever-prevalent phishing email. These emails are sent to billions of email addresses and have the goal of tricking the user into clicking a malicious link to go to a counterfeit copy of a trusted site, or downloading a virus disguised as a legitimate file. Phishing techniques are improving rapidly, but in my research, I noticed a similarity that many share. The target demographics for phishing emails have a large age variance; however, people that are less technologically skilled are very prone to falling victim to the scam. Although email spam filters are able to catch some of these emails, many are still able to slip through. Additionally, many users overlook these protection mechanisms because they believe the emails are credible due to not identifying the core inconsistencies in the email's information. This educational website will provide companies and the public with valuable information to better acquaint themselves with common and identifiable signatures and inconsistencies shared by the majority of phishing emails. Furthermore, there is an included interactive mock email client that will allow users to personally identify problems with emails in order to encourage them to thoroughly examine all email components in their day-to-day lives.

**Student researcher(s): Aminata Bangura and Josie Jerge**
**Major: Biology**
**Research Mentor(s): Dr. April Wynn**
**Project Title: Effect of phosphorus on root hair number in the Arabidopsis thaliana mutant Axr2-1**

Phosphorus availability is a one of the main constraints of plant growth throughout the world. Arabidopsis thaliana exhibits increased extension of root hairs and a higher number of root hairs in response to low phosphorus growth conditions. Auxin and ethylene are the two main hormones that control root hair growth. The axr2-1, an auxin signaling mutant, is a darker green dwarf plant that has delayed root development, few root hairs, and gravitropic root defects. Wild-type and the axr2-1 mutants treated with high levels of phosphorus were examined to determine the effects of increased phosphorus on root hairs. It is expected that the axr2-1 mutant will have no root hairs while the wild-type will have a reduced number of root hairs. Gene expression analysis of auxin response genes will indicate if reduction of root hairs correlates to changes in auxin levels as a result of high phosphorous levels.

**Student researcher(s): Rachel Bellamy**
**Major: Biology; GIS Certificate**
**Research Mentor(s): Dr. Marco Millones-Mayer**
**Project Title: Multivariate Analysis for Malaria Prevalence in Ghana**

Climate has a direct influence on the lifecycle of the Anopheles mosquito and thus can be a determinant for malaria incidence. Mosquito breeding sites and habitats are sensitive to water content, humidity, and temperature. Identifying suitable mosquito habitat areas will therefore be necessary in the process of investigating the spatial patterns of malaria prevalence. Malaria transmission varies highly according to the ecological zone and season. Plasmodium falciparum is the primary malaria parasite in Sub-Saharan Africa, accounting for the vast majority of Sub-Saharan African malaria mortality and making up more than 95.0% of the parasite species in Ghana. Since malaria prevalence can be the product of many complex variables, including climate, land cover, and socio-economics, among others, it is necessary to conduct a multivariate analysis, which will give light to which factors are more influential than others. The aim of this study is to describe malaria prevalence trends and analyze the impact of environmental variables on malaria prevalence in Ghana. This project will model Falciparum malaria prevalence in Ghana using data from the Malaria Atlas Project (MAP) at

the district level. In addition, a Land Use and Land Cover (LULC) dataset will help to evaluate how different land cover areas and land cover changes from 2000 to 2013 affect malaria prevalence. Results are expected to replicate the spatial patterns found in the MAP. Based on prior studies, it is expected that malaria prevalence will correlate with areas involved in agricultural activities, settlement areas, and the Upper West Region, which is the poorest and one of the most affected by malaria burden.

**Student researcher(s): Arnita Best**
**Major: Mathematics Studies**
**Research Mentor(s): Dr. George Meadows**
**Project Title: Teaching Coding to School-Age Students**

Coding is a basic literacy skill in the digital age, and it is important for kids to learn and be able to work with and understand the technology around them. Having children learn coding at a young age prepares them for the future. Coding helps children with communication, creativity, math, writing, and confidence. For IDIS 407, coding materials researched that teachers can use in their classrooms (apps, books, robots) were used in a real world setting with school-age students to teach them coding. The on-site teaching was provided at Hazel Hill Apartments as a STEM night every other week for an hour as part of their after-school homework assistance program for diverse, low-income elementary and middle school students. Students were first taught pre-coding skills with the use of toys such as Ozobots, Botley, and the Code and Go Mouse. They were later introduced to block-like coding language with Scratch Jr. and Scratch on iPads and Chromebooks provided to them. They were then exposed to and learned how to program robots like Dash and mBot using block-like coding languages. As a result of students' interest in making their own robots, they made Brushbots just by attaching toothbrushes, pager motors, and batteries together. As demonstrated by the elementary and middle school students in the Hazel Hill after-school program, coding is fun and educational. The students were excited to participate in the STEM nights. There was active student engagement as they learned to code. Coding is an extremely creative activity and the students enjoyed the reward of seeing their code come to life. These opportunities to learn the basics of coding as a young student can lead to a stronger future in STEM.

**Student researcher(s): Olivia Blake**
**Major: Biology**
**Research Mentor(s): Dr. Deborah O'Dell**
**Project Title: Dopamine Receptor Expression in Worker Honey Bees in Response to Queen Mandibular Pheromone**

Honey bee queens regulate worker bee behavior and physiology by releasing Queen Mandibular Pheromone (QMP). In the absence of QMP, dopamine receptor (AmDOP1) levels increase in the brains of worker honey bees which is associated with behavioral changes in the bee (Beggs et al. 2007) and ovariole development in queenless bees (Harris and Woodring 1995). Abdominal ganglia in queenless worker honey bees also show growth (O'Dell 1995) with ovariole development, however, the mechanism underlying this growth is unknown. This study examines whether the increase in the abdominal ganglia size is similarly accompanied by increases in dopamine and dopamine receptor expression. The hypothesis is that worker honey bees (Apis mellifera mellifera) reared in the absence of QMP will show an upregulation of the dopamine receptor (AmDOP1) mRNA and tyrosine hydroxylase (TH) mRNA within the abdominal ganglia compared to those workers which have been exposed to QMP. This was tested by physically measuring the A6 and A7 ganglia in honey bees reared under two conditions (+QMP or -QMP) and using RT-qPCR to examine gene expression of AmDOP1 and tyrosine hydroxylase (TH). Measurements of A6 and A7 abdominal ganglia consistently demonstrated that the -QMP bees had larger ganglia than those treated with QMP. Only A7 ganglia showed statistically larger growth ($p \leq 0.001$). Bees in the absence of QMP displayed downregulation of AmDOP1 but upregulation of TH when compared to +QMP bees. This is contradictory to expectations, and suggests that the structural increases in abdominal ganglia of Apis mellifera mellifera is mediated by a different pathway than what is seen in the brain. Further study is necessary to establish the role of QMP on the changes in the abdominal ganglia.

**Student researcher(s): Ilana Bleich, McKinley Groves, Amy Guzulaitis, Paige McLachlan, Rachel Thayer**
**Major: Historic Preservation**

**Research Mentor(s): Dr. Andrea Smith**
**Project Title: Waste Management in Fredericksburg, Virginia**

Trash management is an invisible force behind the health and image of a city. Americans produce more than 250 million tons of trash per year with no sign of that growth slowing, and coupled with the disappearance of recycling programs, trash management is becoming a major issue for city planners. In this senior-level Historic Preservation Planning lab, ten students worked with Dr. Andrea Livi Smith to prepare a new trash management plan for downtown historic Fredericksburg in partnership with city officials. This process involved academic research, a geographic survey of Fredericksburg's waste receptacles, interviews with public officials in similar cities, conversations with local business owners and stakeholders, and surveys of passersby in downtown. Based on the results and analysis, the final report presents suggestions for strengthening waste management to be implemented in Fredericksburg, including increasing the number of trash and recycling receptacles in high foot traffic areas and parks, promoting opt-in initiatives such as a city-wide water bottle refilling program, redesigning and distributing educational materials, and improving public policy to better suit the needs of business owners. If implemented correctly, these recommendations will improve life for residents and visitors of Fredericksburg.

**Student researcher(s): Shannon Bremer**
**Major: Historic Preservation**
**Research Mentor(s): Dr. Lauren McMillan**
**Project Title: A Soldier's Words: Literacy and Writing at Sherwood Forest Plantation During the Civil War**

Sherwood Forest Plantation (44ST615) in Stafford County Virginia was occupied from the mid-19th century through the late 20th century. During the Civil War, specifically during the Battle of Fredericksburg, Sherwood Forest was used by the Union Army as a general encampment, a field hospital, and a reconnaissance station. Through the University of Mary Washington field school during the summers of 2015 until 2017, we discovered various objects related to writing and literacy, including several inkwells, master inks, and glass stoppers. In this paper, I will discuss the writing related artifacts found on the site and what they can tell us about the importance of literacy, letter writing, and diary writing during the Civil War, and more specifically, how that is related to what we know about Sherwood Forest from an officer's and surgeon's perspectives.

**Student researcher(s): Renee Brittigan**
**Major: English with a concentration in Creative Writing and Psychology**
**Research Mentor(s): Dr. Warren Rochelle**
**Project Title: The Residual: a Novel**

Brittigan will read an excerpt from the two chapters of the novel she wrote this semester, entitled The Residual. The novel is a fantasy about a young woman named Maron whose best friend mysteriously disappears and just as mysteriously reappears months later, changed. Maron is confronted by odd and mystical runes, foreboding powers, and best friend's sanity.

**Student researcher(s): Kelsey Burham**
**Major: International Affairs**
**Research Mentor(s): Drs. Chad Murphy and Robert Barr**
**Project Title: Supply and Demand: Understanding Continued Opioid Drug Trade Between Latin America and the United States**

An analysis of the Opioid Epidemic at home and abroad, and why the War on Drugs has yet to generate any positive results. The theory of Supply and Demand is applied to the epidemic to better explain the problem and how it should be addressed by the American government. This project will have an in depth analysis of the effects of the epidemic and drug trade on US and Latin American citizens and governments. It will also apply economics while considering this issue and explain why solutions or improvements have not been made toward the Opioid Epidemic or the "War on Drugs" in general. My thesis proposes the hypothesis:
H1: Government policies directed at addressing and treating opioid addiction within the United States will decrease society's demand, and in turn this will decrease the trade of illicit drugs.

Results generated using R Studio are expected to show that addressing demand by increasing treatment possibilities within the US will in turn decrease opioid use among Americans, thus negatively impacting the Latin American supply according to the laws of Supply and Demand.

**Student researcher(s): Cecelia Burkett**
**Major: Business Administration - Marketing**
**Research Mentor(s): Dr. Lance Gentry**
**Project Title: Trends and Effects of Advertising Legal Addictive Substances in the United States**

Legal addictive substances advertised in the United States include sugar, caffeine, alcohol, and tobacco. Alcohol and tobacco advertising are of special significance since their consumption is leads to high risks of addiction and is known to cause adverse health effects. The existence and use of alcohol and tobacco has existed since ancient times; the historical presence of both substances are examined in this report. Consumer attitudes towards alcohol have ebbed and flowed through waves of religion and morality. Attitudes towards tobacco have developped from acceptance in ceremonial and psychological use to wariness due to health concerns. Although advertising spending of alcohol has more than quadrupled in the last century, consumption remains relatively stable. Tobacco advertising for cigarettes and for cigarette alternatives has increased over the last century. While alcohol use remains stable with an increase in advertising spending, tobacco consumption over time remains varied. Tobacco advertising expenditures are increasing, while cigarette sales drop and sales of other forms of tobacco consumption, such as e-cigarettes, increase. The advertisement of tobacco and alcohol in the United States raises questions regarding free speech, ethics, and corporate social responsibility.

**Student researcher(s): Robert Byles**
**Major: Environmental Science**
**Research Mentor(s): Dr. Alan Griffith**
**Project Title: Quantifying Ecosystem Services of Landscaped Trees and Woodlots on the University of Mary Washington Campus**

Organisms have processes that they undergo for various reasons called ecological functions. While ecological functions inherently have no benefit to humans, humans can derive worth from them in the form of ecosystem services. Our study quantifies the ecosystem services of trees on the University of Mary Washington's campus, including carbon storage, carbon sequestration, energy effects, storm water runoff mitigation, oxygen production, and pollution removal. In addition, we will determine what effect specific species and locations have on the total benefit of ecosystem services. The two locations for comparison are landscape trees, trees planted and maintained by groundskeepers, and woodlot trees, trees on campus outside of active maintenance. After collecting tree measurements in the field (including species, diameter at breast height, tree height, and crown width), we will use i-Tree Eco (v6) software to estimate the values of the ecosystem services. Data requirements for the landscaped trees are simple, as a complete inventory of these trees exists. For a complete inventory, i-Tree Eco only requires two measurements: species and diameter at breast height. We will also include tree height and crown width in order to increase accuracy of estimations. Using a complete inventory is unfeasible for measuring the ecosystem services of woodlot trees due to the high number of trees and large area. We will randomly sample plots and record species, diameter at breast height, percent canopy cover, and percent of plot measured at each sample location. We will analyze the data on campus-wide scale as well as a per-species scale. The results of this study will be useful to UMW's Department of Landscape and Grounds, as they will be able to enjoy enhanced justification of expenditures on pruning, pest control, cabling, fertilizing, aeration, and protection from removal due to new construction.

**Student researcher(s): Mandy Byrd, Cindy Ly, and Garrett O'Donnell**
**Major: Data Science**
**Research Mentor(s): Drs. Debra Hydorn and Melody Denhere**
**Project Title: Analysis of Environmental Performance by Region and Income**

We obtained data from a 2016 study from Yale University on the Environmental Performance Index (EPI) to investigate how the issue of environmental sustainability is affecting the world today. We were able to identify flaws in the interpretation of the EPI score due to the weighting factors used to combine variables that impact environmental sustainability. We examined their statistics with different methods including descriptive statistics,

Analysis of Variance (ANOVA), and Principal Component Analysis (PCA) to identify factors that may influence the results that did not appropriately account for the different income and region groups of the countries. Based on our research, we believe that the EPI score developed by Yale University was not entirely accurate because of their weighting system, the negligence to divide the countries into regional and income groups, and the lack of focus on differences between individual countries.

**Student researcher(s): Emily Contompasis**
**Major: Biology**
**Research Mentor(s): Dr. April Wynn**
**Project Title: The Effects of Environmental Conditions on Expression of the ETTIN (ETT) Gene in perianthia (pan) Mutant Arabidopsis thaliana**

This experiment investigated how light exposure and temperature effect expression of the ETTIN (ETT) gene in perianthia (pan) mutant Arabidopsis thaliana plants and examines the penetrance of pan mutant-related floral patterning defects under different environmental conditions.

Arabidopsis with pan mutations produce flowers with floral patterning defects, notably additional petals. Reduced day length has been shown to compound these phenotypic defects. Previous studies analyzed the effects of day length on gene expression in Arabidopsis and found that light exposure influenced expression of genes that govern floral patterning like PAN and ETT. I propose that stressful environmental conditions (including reduced light levels) will reduce ETT expression in pan mutants and thus cause the exhibited floral patterning defects. ETT is a gene thought to have partially redundant function with PAN with regard to floral patterning, but ETT expression in pan mutants has not previously been analyzed. This experiment assessed whether changes in environmental conditions resulted in variable penetrance of the pan mutant phenotype (5- instead of 4-petal flowers). Following the idea that without PAN function, the variable phenotype is the result of variable ETT expression and its ability to compensate for the loss of pan function. This research aimed to assess three main objectives. The first was to determine the effects of the reduction of day length (from 16 to 8 hours) on expression of ETT in pan mutant flowers compared to wild-type, the second was to determine the effects of heat and cold stress on expression of ETT in pan mutant flowers compared to wild-type, and the third was to determine the frequency of pan mutant phenotypes under each stressful environmental condition compared to optimal growth conditions.

**Student researcher(s): Emily Contompasis and Abbi Conklin**
**Major: Biology**
**Research Mentor(s): Dr. April Wynn**
**Project Title: MWCF Herbarium Digitization: Plant Preservation in the Age of Technology**

The University of Mary Washington Herbarium (MWCF) houses a collection of more than 8,500 preserved plant specimens, some of which are more than a century old. The Herbarium digitization is an ongoing project that involves scanning each specimens and uploading high resolution images and the corresponding plant information to two databases Eagle Scholar (UMW repository for special archives) and SERNEC (SouthEast Regional Network of Expertise and Collections), which is an NSF funded consortium of 233 herbaria in located in 14 states in the southeastern United States. In addition to the databases, the MWCF Herbarium has established an Instagram page as a public outreach and education effort to teach about plant biology and the importance of specimen preservation. This year, students enrolled in Honors 201 (The Honors Program service learning course) and Herbarium volunteers have helped to collect, press, preserve, and digitize approximately two dozen newly collected specimens with the goal of adding more plants from the University of Mary Washington campus and surrounding areas in Fredericksburg including Gari Melchers' Estate (also known as Belmont) in Falmouth, VA.

**Student researcher(s): Reed Cornwell, Jillian Stone, and Andrea Abell**
**Major: Chemistry**
**Research Mentor(s): Dr. Randall Reif**
**Project Title: Quantification of Free Chlorine Residue on PVC Pipes By Uv-Vis Spectroscopy**

PVC pipe is made from PolyVinyl Chloride, a mixture of plastic and vinyl, of which the main reagent used in the production of PVC pipes is Chlorine gas. PVC piping most often is used to hold high pressure water in

main water supply lines. Potentially high concentrations of Chlorine can contaminate drinking water, leading to major health effects such as respiratory and heart problems. By leaching PVC pipes in Nanopure Water, we hypothesize that the Chlorine residue will react with the water to create Chlorine, environmentally Hypochloric acid. Chlorine is colorless; thus, DPD Free Chlorine Reagent Powder Pillows will be used to react with the Chlorine to produce a magenta dye that absorbs light. The concentration of the DPD is directly proportional to the concentration of Chlorine. Using the magenta dye, standards of various concentrations will be analyzed using UV-Vis Spectroscopy. The wavelength of maximum absorbance will be measured for each standard and plotted against their concentrations. DPD will also be added to a small portion of the PVC leached water and run through using the same analytical technique. The calibration curve will be used to determine the concentration of the analyte in the sample. The expected results will be from 0-1 ppm.

**Student researcher(s): Peyton Crickman**
**Major: Psychology**
**Research Mentor(s): Dr. Emily Stanley**
**Project Title: Perfectionism as it relates to Error Related Brain Activity**

The Error Related Negativity (ERN) is an Event Related Potential (ERP) that is associated with making mistakes. The ERN has been shown to have a higher amplitude for those with anxiety disorders, and in those who report high levels of worry. However, even after successful treatment, the ERN maintains its high amplitude, which suggests that the ERN may be related to more stable biological factors. The present study examines the relationship between the ERN and several facets of perfectionistic personality traits. Personality traits tend to be more stable over time than anxiety symptoms, so they may be a more stable correlate for the ERN. The results revealed that two facets of perfectionism, doubt about actions and planfulness, are significant predictors of the ERN. These facets seem as though they are most related to error-monitoring.

**Student researcher(s): John Cronin**
**Major: Political Science**
**Research Mentor(s): Dr. Stephen Farnsworth**
**Project Title: The "Will of the Voters": Examining Legislative Repeal of State Ballot Initiatives**

Direct democracy plays a significant role in 24 states across the country. The process of allowing the public to gather signatures, place an issue on the ballot, and then approve it represents the purest form of democracy and provides the ultimate check on unresponsive legislatures. However, in some cases ballot initiatives are repealed by state legislatures after being approved by voters. This research paper asks the following question: are there identifiable trends to the legislative repealing of direct ballot initiatives after they have been approved by the majority of the voting public? After considering past arguments and history surrounding initiatives, this paper observes five case studies that state legislatures tried to repeal. It finds that the legislature tends to using outside entities to justify repeal (blaming out-of-state groups and utilizing the judiciary), and that if repeal is taken up, total repeal bills are generally introduced first. It also observes that states with less rules surrounding legislative alteration will introduce repeal easier, and can apply "emergency clauses" to pass repeal bills with no possibility of voter referendum. Finally, it finds that the governor's role in the repeal process is less about party and more about optics. This is distinct from the state legislature, whose members will usually side with their party even if their constituents hold the opposite opinion. Based on these trends this project proposes solutions— most notably increased oversight of emergency clauses and more voter awareness of the process. It also gives recommendations for future research in the subject.

**Student researcher(s): Damon Dixon**
**Major: Business Administration**
**Research Mentor(s): Dr. Kashef Majid**
**Project Title: Quantifying Creativity with Facebook Marketing**

Prior to 2012, businesses easily survived without any advertising online. Companies did not have departments set up for online customer relationship management. They also did not need an online footprint. However, times have changed for many businesses. Consumers now actively search the Internet for everything they need. For entertainment, research, and buying consumers spend hours on the internet for information. Even if they need to go to a store to pick it up after they've completed their search. For most people, (especially the younger

generation; millennials and the generation Z), the rule is: "If you're not online, then you don't exist". One of the online networks that have remained dominant for years is Facebook. For businesses, both big and small, it is a recommended platform for advertising because of its worldwide membership. This large reach has a positive effect on CPM's for advertisers. CPM or Cost Per Thousand Impressions, is the key metric in determining how expensive it is to serve an advertisement to an audience. At scale, Facebook Advertising offers business a unique offering to reach large parts in their exact target markets. By creating technical backend marketing funnels combined with high quality social advertisements, businesses are able to generate sustainable amounts of sales. All while having every single dollar accounted for and tracked with proper website pixel tracking.

**Student researcher(s): Thanh-Binh Duong**
**Major: Earth & Environmental Sciences**
**Research Mentor(s): Drs. Tyler Frankel and Ben Kisila**
**Project Title: Microplastics: Presence, concentrations, and influence on toxicity of methoxychlor to Daphnia magna**

Microplastics (MPs) are defined as plastic particles <5mm in diameter which are generated through the manufacturing of microbeads for cosmetics and personal care products, as well as from the physical and chemical fragmentation of larger plastic pieces. MPs primarily enter aquatic environments through wastewater treatment plant (WWTP) discharge, where they can remain suspended and navigate into connected waterways or deposit into sediments. Due to their small size they are easily ingested by aquatic organisms, resulting in detrimental health effects such as digestive tract obstructions, feeding debilitation, and overall energy depletion. MPs have also been suspected to sorb and mobilize chemicals such as pharmaceuticals and pesticides, suggesting that interactions between these two types of pollutants may result in an altered biological response compared to the effects of each individual contaminant. This study assessed 1) the presence and concentrations of MPs in sediment samples obtained downstream from a wastewater treatment plant and 2) the potential synergistic or antagonistic effects of polyethylene MPs and the organochlorine pesticide methoxychlor on the viability and behavior of Daphnia magna. Water and sediment samples were obtained from the Little Falls WWTP outfall (Stafford, VA) and the presence, type, and quantity of MPs were assessed using light microscopy. Adult D. magna were exposed to either 1) virgin 10-20μm polyethylene pellets or 2) methoxychlor for 48hrs using a static exposure method. Mortality and mobility were assessed every 24hrs for all treatments, as well as the degree of ingestion by each individual for the MP treatments. Future studies will examine the effects of the toxicants combined. Thus far, few studies have examined the ability of MPs to influence the toxicity of organochlorine pesticides and other chemicals. Our findings will help to expand what is known about the impacts of MP pollution on aquatic environments.

**Student researcher(s): Students in EDUC 311**
**Major: Varied**
**Research Mentor(s): Dr. Melissa Wells**
**Project Title: Arts Integration in Action: Creating Content-Focused Children's Books for Local Elementary Classrooms**

Children's literature is a powerful tool for instruction in elementary classrooms, but sometimes the resources to teach certain content areas using age-appropriate books simply don't exist. Students in EDUC 311 partnered with local elementary teachers to identify a need for a curriculum-focused children's book. They then worked in groups to research the topic and create a piece of children's literature using famous children's book author/illustrator Eric Carle's collage technique. Students will share their process and product, along with reflections on their growth as future educators integrating the arts through this community engagement project.

**Student researcher(s): Kathleen Elliott**
**Major: Environmental Geology**
**Research Mentor(s): Dr. Pamela Grothe**
**Project Title: The Seasonality of Oxygen and Hydrogen Isotopes of Rain, Stream and Groundwater in Fredericksburg, VA**

Stable isotopes of oxygen and hydrogen, $\delta^{18}O$ and $\delta D$, are tracers of climatic changes within the hydrologic cycle, and thus are a potential link in the relationship between climate-influenced changes to the hydrologic

cycle and modern and paleoenvironments. Studies have shown that the isotopic content of surface water and groundwater parallel meteoric water (e.g. Dutton et al., 2005), a relationship expected to be reflected in marine paleoclimate archives, such as those from the Chesapeake Bay, which are sensitive to freshwater input from rivers (e.g. LeGrande and Schmidt, 2009). In this study, we establish a baseline of isotopic composition of precipitation, stream, and groundwater in Fredericksburg, Virginia. The isotopic content of water in the Fredericksburg region was analyzed over the course of a year to understand the seasonality of the δ18O and δD of precipitation, and its relationship between the isotopic values of river water and groundwater. Surface water samples were collected from the Rappahannock River and Hazel Run tributary in Fredericksburg, VA, and precipitation and groundwater samples were collected on the University of Mary Washington campus. We expect to find that precipitation in winter months are more depleted in heavy isotopes than in warmer months. We also expect to see a correlation between the δ18O and δD values of precipitation and river water, with river water values reflecting averaged meteoric water values; however, periods of prolonged dryness may result in deviations from this trend due to high rates of evaporation. This work will provide the foundation of using δ18O and δD of meteoric water to study changing precipitation patterns as climate changes in the local Fredericksburg, VA region, as well as understanding the controls of the δ18O and δD of surface water for more robust interpretations from proxy records in regional paleoclimate studies.

**Student researcher(s): Will Everett**
**Major: History**
**Research Mentor(s): Dr. Claudine Ferrell**
**Project Title: "The Sacred Fire of Nationality:" Irish Public Opinion of Irish Nationalism in the Wake of the Easter Rising of 1916**

Irish public opinion on Irish nationalism changed in the wake of the 1916 Easter Rising. Two primary reasons for this shift are the cultural and historical significance of the rationale of the rebels who led the Rising, and the harsh response of the British government. The rise of the Irish nationalist movement in the aftermath of the Rising is a direct result of the increase in popular support for Irish nationalism from the end of the Rising on April 29, 1916 through the end of that year.

**Student researcher(s): Isabel Faust, Allison Burgess, Riley Manthey**
**Major: Environmental Science**
**Research Mentor(s): Dr. Melanie Szulczewski**
**Project Title: Analysis of Drinking Water Quality in Buildings at the University of Mary Washington**

Today, less than 1% of the Earth's water is freshwater available for drinking. This percent is expected to decrease over the next decades due to climate change, a decrease in hotspot biodiversity and heightened natural disasters. This makes it important to protect and maintain safe drinking water quality. This project analyzed drinking water from buildings on the campus of the University of Mary Washington in Fredericksburg, Virginia, for pH, chlorine, and various metals including: aluminum, arsenic, beryllium, cadmium, copper, iron, lead, manganese, nickel, selenium, vanadium, and zinc. Water was collected from bathroom sinks from each building on campus using the EPA Quick Guide to Drinking Water Sample Collection by running the water for two minutes, rinsing bottles three times, and filling them. Samples were tested on-site for free available chlorine and total residual chlorine using EPA Approved test kits. Then, the pHs of all the samples were recorded before being stored in a fridge at 4°C. The samples were then analyzed for metals using inductively coupled plasma-atomic emission spectroscopy (ICP-AES). Results show that pH ranged from 6.26 to 7.80, with a distinct decrease in pH occurring in all samples collected after November 18th; free available chlorine ranged from 0.1ppm to 2.0ppm; and total residual chlorine ranged from 0.8ppm to 3.0ppm. The EPA recommends pH to be between 6.5 to 8.5, total residual chlorine to be less than 4 ppm, arsenic to be less than 0.01 ppm, cadmium to be less than 0.005 ppm, and lead to be at 0 ppm. The source of the water is the same for all campus buildings, and as a result the city of Fredericksburg gets its water from the Rappahannock River through Spotsylvania County Utilities so these variations might be a result of campus infrastructure. Possible trends and correlations will be determined with SPSS statistical analysis.

**Student researcher(s): Lilly Fawcett**
**Major: Anthropology**
**Research Mentor(s): Dr. Jason James**

**Project Title: An Anthropological Study of American Girl Dolls**

The American Girl Company has been in business since 1986. Their company information states that they aim to provide a "doll for every girl;" however, there seems to be a divide between the company's statements and their actions. There have been a number of controversies caused by American Girl's decisions on what type of dolls to produce, the characters' races, and even the heads used to make the dolls themselves. I studied the doll collector community's response to these issues as well as American Girl's official product information to learn more about them; with a specific focus on the anthropological concepts of identity and imagined community.

**Student researcher(s): Stacey Feindt**
**Major: Political Science**
**Research Mentor(s): Dr. Rosalyn Cooperman**
**Project Title: Detained by Data: A Critical Analysis of the Virginia Pretrial Risk Assessment Instrument**

This research is a critical analysis of criminal justice policy in Virginia, specifically, the use of the Virginia Pretrial Risk Assessment Instrument (VPRAI), a computer application designed to help judges make objective pretrial detention and release decisions. Although the VPRAI was originally intended as a tool to further criminal justice reform in Virginia, there has been very little independent inquiry into its use. My research seeks to gather qualitative data through interviews with professional stakeholders and former defendants to address this gap in knowledge, and identify the benefits, consequences, and challenges associated with the VPRAI. I conclude that, at the present time, it is not effectively contributing to reform efforts, and I propose several policy modifications that could improve its use as a tool to eliminate cash bond, lower incarceration rates, and produce unbiased pretrial detention decisions.

**Student researcher(s): Sara Fioretti**
**Major: Biology**
**Research Mentor(s): Dr. Rosemary Barra**
**Project Title: Combined Effects of Chemotherapeutic Agents and Statins on HNSCC**

Worldwide, head and neck squamous cell carcinoma (HNSCC) is the sixth most common cause of cancer with a five-year survival rate of 40-50%. Common treatments include a variety of chemotherapeutic agents and radiation, however only 50% of patients respond to conventional treatments. The high morbidity and mortality rates come from the malignant nature of HNSCC. The overexpression of RhoC GTPase, involved in cell signaling, gene expression, cytoskeleton organization, and cell proliferation, mediates HNSCC metastasis. For RhoC GTPase to function, it must be prenylated to form an association with the cell membrane by HMG-CoA reductase. This enzyme is also involved in the synthesis of cholesterol and is inhibited with the commonly prescribed high cholesterol drug Atorvastatin. Previous studies have shown that inhibiting RhoC GTPase prenylation with Atorvastatin limits HNSCC cells metastatic capability. The purpose of this study is to analyze the effect of statins on the effectiveness of the chemotherapeutic agent cisplatin. SCC15 cells were treated with various concentrations of cisplatin and Atorvastatin. Cell viability was then determined using MTT assay. Preliminary results indicated a decrease in cell viability with Cisplatin but no significant effects with Atorvastatin.

**Student researcher(s): Takesha Foster and Stephanie Weigert**
**Major: Biology**
**Research Mentor(s): Dr. Parrish Waters**
**Project Title: The Effect of Partial Sleep Deprivation on Long-term Memory and Anxiety in Mice**

Sleep plays a large role in mood and the consolidation of memories. Our experimental goal is to detail the effects of sleep deprivation on memory and anxiety using a laboratory mouse model. We focus on the hippocampus as this is the area concerned with both anxiety and memory. We assessed memory by the number of errors in the same Lashley maze before and after sleep deprivation. We analyzed behaviors in the maze, such as hyperactivity, self-trauma, and aggressiveness in handling to identify possible stress and anxiety induced by lack of sleep. Neurologically, memory loss is associated with decreased levels of Cyclic Adenosine Monophosphate (cAMP) in the brain. cAMP is an important intermediary to protein kinase A (PKA), which plays an important role in cell signaling and gene modification for hippocampal function. Decreases in this enzyme results in memory loss. Sleep deprivation also causes increased levels of cortisol in the body, which

leads to stress, anxiety, and cognitive impairments. We observed cAMP in the hippocampus and cortisol levels in blood post-mortem using ELISA assays.

**Student researcher(s): Rachael Friedenberg**
**Major: Historic Preservation**
**Research Mentor(s): Dr. Christine Henry**
**Project Title: "The Many Features Women Want:" The Design and Marketing of Houses towards Women at the Turn of the Twentieth Century**

During the first half of the twentieth century, houses were designed and marketed towards women in a way that enforced gender stereotypes and the idea of an "ideal woman" (one who cooks, cleans, and takes care of the home). This Honors capstone project explores secondary research about women and the home, consumerism, and mass-produced houses during the first half of the twentieth century. This project mainly focuses on analysis of primary sources (including newspaper articles and advertisements in women's magazines) from this time period that enforced stereotypes of women and ideas about a typical, middle-class, female consumer. It also examines how some people during that time resisted these stereotypes about women and the domestic sphere. This research is important because it is interdisciplinary and connects feminist ideals with the built environment.

**Student researcher(s): Jackson R. Gardner**
**Major: Biology**
**Research Mentor(s): Dr. Parrish Waters**
**Project Title: Preferential Responses of Young Rats to Palatable Food vs. Social Play**

Social play, also known as rough-and-tumble, is a type of social behavior that that has been observed in most mammalian species. In rats, as in humans, this behavior is most prevalent from the juvenile phase until mid-adolescence and is a highly rewarding activity. Though it has been shown to be an effective incentive, it is unknown how the rewarding value of social play compares to that of palatable food, a very salient reward. This can be tested by means of a Conditioned Place Preference Test, in which the rats are conditioned to associate each of two different chambers with a different stimulus – in this case either social partner or palatable food (fruity pebbles cereal). To ultimately test each rats' preference, each rat is allowed to freely explore both chambers while the time spent in each chamber is recorded. During conditioning, some rats will be housed in pairs while others will be housed in isolation in order to determine if isolation increases motivation to seek a social partner. We expect rats to spend similar or greater amounts of time in the social play chamber, and that this preference will be enhanced by isolation housing. This would indicate that young rats' motivation to seek social play is comparable to their motivation to seek palatable food. This could suggest that social play may be as much a necessity for the development and survival of rats as other highly rewarding activities such as eating and sex, the functions of which are more obvious.

**Student researcher(s): Hannah Gautsch**
**Major: English & Classical Civilizations**
**Research Mentor(s): Drs. Kate Haffey and Shumona Dasgupta**
**Project Title: Hearing Silences in Cereus Blooms at Night and Tide Running**

Caribbean authors Shani Mootoo and Oonya Kempadoo use silence within their novels to reveal the ways that silence intersects with rage, gender, and class and is capable of both reinforcing and destabilizing privilege. While Mala, the central character of Mootoo's Cereus Blooms at Night, uses her silence to release herself from her father's violent abuse, Cliff, the central character of Kempadoo's Tide Running, is isolated and imprisoned as a result of his inability to speak for himself. When the two books' use of silence is compared, the two characters' unique narratives reveal the ways that silence intersects with gender to allow Mala to use silence to burst patriarchal restraints, but also traps Cliff inside a self-defeating cycle of exploitation and violence. By identifying the ways Caribbean masculinity is confined within these interlocking systems of power, both authors attempt to articulate a space for healing and wholeness outside of the binary of masculine and feminine.

**Student researcher(s): Julia Gibbons**
**Major: International Relations**

**Research Mentor(s): Dr. Surupa Gupta**

**Project Title: Female Secondary School Stipend Programs in Pakistan and Bangladesh**

While many developing countries have reported gender gaps in education, Bangladesh has made remarkable progress and terminated the gender gap in secondary school enrollment through its national Female Stipend Program (FSP) in the 1990s. Conditional Cash Transfer programs (CCTs) like the FSP have become a popular development policy prescription, but the literature on CCTs in South Asia is surprisingly limited. A similar program to the FSP, the Female Secondary School Stipend, was implemented in the Punjab province of Pakistan in 2004 and had modest success, increasing secondary school enrollment for girls by 10%. This paper compares and contrasts the two programs and identifies four factors- program design, education system differences, political factors, and economic factors- in order to offer possible explanations as to why the Bangladesh's program was more successful. The paper draws upon what we can learn from Bangladesh's accomplishment, in order to provide insight and recommendations for the Pakistani program and contribute to the gap in the literature in South Asian CCTs. Results are discussed.

**Student researcher(s): Josephine Gray, Carmen Martinez**

**Major: Biology**

**Research Mentor(s): Dr. April Wynn**

**Project Title: Assessing differences in drought stress response between an heirloom tomato cultivar, Blue Beech, and a large-fruit tomato cultivar, *Bigdena***

In a changing climate, crops are facing more stress than ever before, and agroindustry faces a much greater imperative to focus production on the most stress-resistant crops available. Drought stress is one of the most prevalent of these stresses, alongside temperature and salinity stress. Tomatoes (Solanum *lycopersicum*), the second most-consumed vegetable in the U.S., are especially vulnerable to drought stress. Interestingly, some cultivars of tomatoes appear to be significantly more drought tolerant than others. The reason for this is not always clear, and molecular techniques are being employed more and more to gain a better understanding for these differences. The sheer abundance of tomato cultivars- including those bred for high yield, shelf longevity, or great taste- prompted us to inquire into how breeding decisions may have shaped tomato plant fitness under drought stress conditions. One way to assess plant stress response is to measure the expression of stress response genes. Prior studies have shown that *le16* and *le25* are among a handful of tomato genes that are expressed under drought stress; in particular, as levels of the stress hormone abscisic acid (ABA) raise within the plant. In this manner, we have evaluated differences in drought stress response by comparing *le16* and *le25* gene expression between *Blue Beech*, an heirloom tomato cultivar, and *Bigdena*, a large-fruit tomato cultivar. We predicted that *Bigdena* would have less effective drought stress response, i.e., have lower levels of *le16* and *le25* expression compared to *Blue Beech*, due to a prioritization of reproductive growth over vegetative growth.

**Student researcher(s): Rachel Gunraj**

**Major: Chemistry/Psychology**

**Research Mentor(s): Dr. Janet Asper**

**Project Title: IR Analysis of Microplastics**

Microplastics are plastics that are less than 5 mm in size. They enter the environment when plastic items are improperly disposed of and broken down by water or animals. Dr. Andrew Dolby and Thomas Bustamante (Biology) are collecting duck and goose carcasses and feces quantitative analysis of the microplastics in birds in the Rappahannock region. Chemistry can complement this work by identifying these plastics, potentially using infrared (IR) spectroscopy. This semester, I collected numerous consumer plastics from recycling bins and the roads surrounding UMW. These samples were cut, shaved or filed into microplastic sized particles and analyzed by attenuated total reflectance infrared spectroscopy (ATR-IR). I found that the plastics could easily be distinguished by IR. All of the spectra were saved into a "library" that will be used to identify the plastics from waterfowl next fall.

**Student researcher(s): Shivani Gupta**

**Major: Physics**

**Research Mentor(s): Dr. Maia Magrakvelidze**

**Project Title: Optical Trapping of Nanoparticles**

Upconversion nanocrystals undergo the process of upconversion wherin the absorption of multiple photons results in the emission of higher energy photons. Of particular interest in medical research is the upconversion of Sodium Yttrium Fluoride Nanocrystals, which absorb incident infrared radiation and emit visible light. Potential applications include the ability to perform tissue imaging without exposure to dangerous higher energy radiation. Research protocols were developed for the study of upconversion in Sodium Yttrium Fluoride nanocrystals at specific incident wavelengths in the near-infrared range produced by lasers.

**Student researcher(s): Logan Hargis**
**Major: Biology**
**Research Mentor(s): Dr. April Wynn**
**Project Title: Transgenic Arabidopsis**

The dinoflagellate, Lingulodinium polyedra, evolved a gene that allows it to bioluminescent that it known as Luciferase (LCF). The first type of this genetic trait was found in the firefly species, Photinus pyralis. Luciferase is the classification of enzymes that produce bioluminescence through an oxidative reaction. The LCF enzyme from the dinoflagalate L. polyedra has been examined in species, but not incorporated into a plant species. The experiment will entail isolating LCF from the DNA of the L. polyedra species and transferring it into a viral vector that will be used to infect Arabidopsis thaliana plants. The seeds harvested from the infected plants will be grown in a selective media so that only transformed seeds will grow. After the transformed plants have been grown to maturity leaves will be assayed for RNA expression of LCF.

**Student researcher(s): Katie Hartraft, Chris Ringham, Mandy Byrd**
**Major: various**
**Research Mentor(s): Ms. Martha Burtis**
**Project Title: Domain Fellows: A Student Cohort about Domain of One's Own**

Over the past two semesters, a group of students have participated in Domain Fellows. Each student Fellow spent this time exploring their own digital identity on Domain of One's Own and creating onine projects on the platform that were intrinsically important to them. Projects include an online art portfolio, a podcast series, a creative storytelling exploration, and an online family history site.

In addition, the Fellows served as ambassadors for Domain of One's Own to the rest of campus. They hosted several Domain Day events, at which UMW students could sign up for their own domain, and they promoted the project and their program at Club Carnival in the fall and spring. Fellows also contributed to a group blog exploring issues of online identity and digital literacy.

**Student researcher(s): Sterling Heyns**
**Major: Physics**
**Research Mentor(s): Dr. Maia Magrakvelidze**
**Project Title: Virtual Solenoid Project**

The virtual solenoid is a theoretical machine that uses the electrodynamic properties of electrons to create an electromagnet. This machine, which we are creating a mathematical model for, is a vacated pressure vessel with an electron emitter attached to one side of it and perpendicular sets of wired solenoids running down its sides. A stream of electrons runs down the length of the pressure vessel and will be forced into a helical pattern by a magnetic field that is orthogonal with the electrons' velocities. These loops of moving electrons will form magnetic moments which will superimpose and give off a magnetic field just like a wired solenoid would. It may seem counterintuitive to create a virtual solenoid out of a combination of physical ones, but our calculations suggest that this formation creates a magnetic field stronger than the physical solenoids are capable of producing together. By producing a solenoid in this manner we can create a stronger magnet using less current than necessitated by the relations which dictate physical, wired solenoids. Since electronic parts that can withstand greater amounts of current are more expensive, the virtual solenoid can be used to make a more powerful electromagnet with cheaper parts.

**Student researcher(s): Mary Hoffman**
**Major: Earth and Environmental Sciences**
**Research Mentor(s): Dr. Tyler Frankel**

**Project Title: Sublethal Effects of Sulfoxaflor on Behavior and Physiology of *Daphnia magna***

Insecticides are widely used to control invertebrate pest populations that threaten crop health, and often enter nearby waterways due to improper application methods or as a component of agricultural runoff. Sulfoxaflor, a sulfoxomine pesticide that has recently been approved by the USEPA, has shown increased rotational use due to the lack of cross-resistance exhibited by many insect species. Sulfoxaflor binds to insect nicotinic acetylcholine receptors (nAChR), causing overactivation of these receptors which leads to paralysis and ultimately death. Preliminary exposure studies using rats and mice have shown neonatal abnormalities and the development of liver tumors, and slight effects to the growth of fathead minnow and moderate oral toxicity in birds have also been observed. Little research into the lethal and sub-lethal effects of sulfoxaflor on aquatic invertebrates has been conducted since its approval for use. As such, this study is designed to identify the potential effects of sulfoxaflor at 0, 0.1, 1, 10, 100, and 1000 μg/L on Daphnia magna physiology and behavior. D. magna were exposed to treatments for 24hrs and the number of paralyzed or dead individuals assessed after 24hrs in order to identify sublethal concentrations. To determine the impacts of sulfoxaflor on mobility, adult individuals were assessed using ToxTrac behavioral analysis software. To examine effects on heart rate, individual adults were exposed for 24hrs and heartrate (bpm) assessed at the end of the 24hr exposure. While this research is still ongoing, it has been found that exposure to sulfoxaflor induces arrythmia and heart cessation in adult D. magna as well as having a negative impact on overall mobility at higher concentrations. Our results will help to elucidate the potential impacts of sulfoxaflor pollution on aquatic environments.

**Student researcher(s): Lindsey Jones**
**Major: Chemistry**
**Research Mentor(s): Dr. Davis Oldham**
**Project Title: Synthesis of piperidinol-based inhibitors of KasA: A novel treatment for Mycobacterium tuberculosis infection**

Tuberculosis is the leading cause of death from infectious disease in the world. Although tuberculosis drugs exist, the rise of multidrug-resistant and extensively drug-resistant tuberculosis has created a need for new research. Identifying novel, effective drugs for treatment of tuberculosis could reduce the cost of care and treatment time, saving millions of lives. The enzyme KasA, which synthesizes part of the bacterial cell wall, has been identified as an attractive drug target. A virtual screen using KasA discovered a compound, 4-(4-bromophenyl)-1-pyrenemethyl-4-piperidinol (1), which inhibited bacterial growth. In this research, derivatives of compound 1 were created for future testing with live bacteria. A lithium-halogen exchange reaction was used to attempt to create a piperidinone-based derivative with varied substituents, but the method yields were low and difficult to purify. A Grignard process was also attempted with similar results. Alkylation of 4-substituted-4-piperidinols was successful in creating derivatives with arylmethyl substituents in yields from 51-85%. A silane reduction to remove the 4-hydroxy group was also explored, but exhibited low yields. In future research, these derivatives will be tested in vitro to determine suitability for future tuberculosis drug research.

**Student researcher(s): Lindsey Jones and Erin Schaeffer**
**Major: Chemistry**
**Research Mentor(s): Dr. Leanna Giancarlo**
**Project Title: Kinetic isotope effect: Determining the mechanism of the rate determining step of the oxidation of 1-phenylethanol to acetophenone**

The kinetic isotope effect describes the different rates of reaction observed between two isotopomers of the same molecule. The primary effect is observed when the bond broken in the rate determining step of the reaction involves the isotopic atom and therefore will display a characteristic ratio of rates that can be predicted based on the different bond dissociation energies of the two different isotopes. In this study, the rates of oxidation of 1-phenylethanol and its isotopomer, 1-deuterio-1-phenylethanol, to form acetophenone were monitored by gas chromatography/mass spectrometry to find the relative rates of the reactions. The ratio of these rates is compared to the predicted ratio for a primary kinetic effect and shown to support the known mechanism of this oxidation, in which the α hydrogen (or deuterium) to the hydroxy group is abstracted in the rate determining step.

**Student researcher(s): Kelly Keane, Marissa Howard**

**Major: Biochemistry, Environmental Science**
**Research Mentor(s): Dr. Abbie Tomba**
**Project Title: The Effect of Clothianidin on the Ability of Crayfish to Respond to Food Odor**

Clothianidin, a Neonicotinoid pesticide, is commercially used as a seed coating on crops, has a high potential for runoff and at high doses has been shown to be fatal to some non-target aquatic invertebrates. It has also been shown to have adverse effects on invertebrates such as crayfish at lower levels. Crayfish are keystone species within their environments and rely on chemical cues to find food and establish social hierarchies within their communities. The objective of this study is to determine if there is an adverse effect of sub lethal levels of clothianidin on crayfishes' ability to respond to food odor. Male *Cambarus acuminatus* crayfish were sourced from Horsepen Run (Stafford County, VA), housed in tanks, given unique ID numbers, and randomly assigned to one of three trials, Control, Food odor alone, and Food odor after Clothianidin. Crayfish assigned to the clothianidin treatment were exposed to 15.0 ppb of Clothianidin for 48 h before behavioral trials. All crayfish were starved for 48 h before behavioral trials. Trials consisted of a 20-minute acclimation period followed by exposing crayfish to two odors sequentially and observing walking leg movement for 2 minutes after each. The control group received two injections of water. The food odor and clothianidin groups received water followed by food odor. Food odor was made from cod steeped in 200 mL of water for 1 hr. then filtered. We predicted that there would be a significant increase in walking leg movement in the food odor trial compared to the control and clothianidin would have an adverse effect on walking leg movement in comparison to food odor as clothianidin effects movement and sensory abilities of invertebrates. Current data is inconclusive; however additional trials are currently being run.

**Student researcher(s): Gary Kellenberger**
**Major: Economics**
**Research Mentor(s): Dr. Don Lee**
**Project Title: Crime, Background Checks, and Politics. The effect of Firearm Background Checks on Violent Crime.**

Firearms are one of the most debated topics in politics for decades. This research uses data from 2008 through 2017 of all 50 States in the US plus Washington D.C. to include their political standing for their Governor, Attorney General, and Delegate Majority. In addition, it includes their federal background checks run for firearm purchases in each state to test the effect that the background checks have on the number of violent crimes in each state.

**Student researcher(s): Hannah Killian**
**Major: Physics**
**Research Mentor(s): Dr. George King**
**Project Title: Effect of Oxide Layer Thickness on Tunneling-Percolation Threshold in Nanoparticle-Polymer Composites**

Nanoparticle-polymer composites (NPC's) consist of an insulating polymer matrix containing nanoparticles. The amount of particles within the polymer can be described by a volume fraction. For NPC's containing metallic particles, the composite transforms from an insulator to a conductor at a specific volume fraction, known as the percolation threshold. Previous studies found NPC's to be conductive at low volume fractions, where the particles were not in contact, suggesting that electrons may be tunneling through the matrix. Additionally, all metallic particles have an inherent oxide shell. Since oxides are semiconductors, the addition of this third layer with different electrical properties increases the complexity of the nanocomposite. This research evaluated the effect of the oxide layer on particles in a nanocomposite through treatment of percolation and quantum tunneling theories to explore the conductive behavior of NPC's in RF fields. Quantum mechanics was used to evaluate the probability of an electron tunneling between two Cu or CuO particles in an insulating polymer matrix. The transmission probability for an electron to tunnel from one Cu nanoparticle to another in a PMMA matrix of a NPC with an electric potential of 60 V was found to be very high, with tunneling probable until approximately 200 nm particle separation. After the incorporation of an oxide shell, the probable tunneling distance between CuO particles increased to 300 nm. A percolation model was constructed in MATLAB, where the tunneling distances for Cu and CuO particles were incorporated to estimate the volume fraction of a NPC. The percolation threshold was found to be lower for composite containing CuO particles. Thus, the addition

of the oxide layer increased the tunneling distance between particles and decreased the percolation threshold needed to obtain a conductive NPC.

**Student researcher(s): Hannah Killian and Melissa Pampel**
**Major: Chemistry**
**Research Mentor(s): Dr. Leanna Giancarlo**
**Project Title: Evaluating the Transition States of the Wittig Reaction Mechanisms by Molecular Modeling**

The Wittig reaction is a vital part of organic synthesis, as it allows for the creation of a stereoselective alkene from the reaction of an aldehyde or ketone with a triphenyl phosphorus ylide reagent. Despite being a commonly utilized reaction, the exact mechanism continues to be debated. Here, two dominant mechanisms will be investigated. The classic mechanism involves the formation of a charged betaine intermediate following a nucleophilic attack on the carbonyl of an aldehyde or ketone by a charged ylide; however, recent NMR studies have suggested the betaine intermediate is not formed. An alternate mechanism has been proposed that indicates the cycloaddition of the two reactants forms an uncharged intermediate. This study seeks to investigate the effect of sterics and solvent composition on the Wittig mechanism by computationally evaluating the reaction thermodynamics and kinetics of both the classic and alternative reaction pathways using HyperChem molecular modeling software. By observing the collision of the reactants, the heat of reaction will be determined. The intermediates that are proposed to form the alkene product will be modeled to compare the stability of the intermediate. We hypothesize that by generating and analyzing energy profiles of each reaction pathway, the kinetic and thermodynamic properties will be distinct, and reveal that the alternate uncharged reaction sequence is more favorable than the classical mechanism.

**Student researcher(s): Emily Knerr**
**Major: Accounting**
**Research Mentor(s): Mr. Ken Machande**
**Project Title: Using Financial Data to Measure Effects of a Changing Economy: A Study of Homeless Shelters**

Changes in the economy can have a large impact on businesses, both for-profits and nonprofits. However, nonprofit organizations are affected differently than regular for-profit businesses. Homeless shelters are an example of an organization that will be affected differently by upswings and downturns in the economy. The state of the economy at a certain point can be evaluated by a variety of factors. Some factors that specifically influence the financial performance of homeless shelters include the homelessness level, poverty rate, unemployment rate, median household income, and per capita disposable income. In this project, I wanted to see if a sample of homeless shelters responded to changes in the economy as expected based on the trends found in certain economic and accounting factors for a specified time period. In order to test this, I first assessed the performance of the economy during the three-year period from 2014 to 2016 by evaluating the five previously mentioned factors. I then researched the corresponding effect that the economic trends shown by these elements should have on the financials of nonprofit organizations, specifically homeless shelters. Finally, I compared the expected accounting trends to the self-reported data from 20 homeless shelters in the Virginia area on their Form 990s during the three-year period to see if they corresponded to the changes in the economy during that same period.

**Student researcher(s): Ethan Knick**
**Major: History and Historic Preservation**
**Research Mentor(s): Dr. Lauren McMillan**
**Project Title: Facing a Mystery: Exploring the Presence of a Lone Native American Anthropomorphic Effigy from a 17th-Century Virginia Plantation**

This paper explores the presence of a single 17th century human effigy head found in a stratified midden on Virginia's Nomini Plantation. It considers post-contact migration, exile, and commerce, which may allow for the possibility of Susquehannock interaction spheres during a period when they were still producing anthropomorphic effigies just to the north of the Potomac and examines the craftsmanship of the piece to discuss where the artifact's maker might have found their inspiration.

**Student researcher(s): Juliana Kolba**
**Major: Biology**
**Research Mentor(s): Dr. April Wynn**
**Project Title: Magnolias of Virginia: Magnolia *grandiflora* and Magnolia *virginiana***

Two Virginia native species of Magnolias, the Magnolia *grandiflora* and Magnolia *virginiana*, have specimens housed in the MWCF Herbarium. Both of these species have very similar properties such as the visual presentation of their flowers and reproduction habits. They were compared for geographic spread, visual and anatomical characteristics, growing conditions and uses. Specimens were examined for location of collection and date of entry using MWCF Herbarium entries in SERNEC. These species are important because they have iconic ornamental blooms. The wood of Magnolia grandiflora is used in furniture creation. They both are nectar sources for many types of beetles and moths.

**Student researcher(s): Ren Koloni**
**Major: Sociology and Women's & Gender Studies**
**Research Mentor(s): Dr. Tracy Citeroni**
**Project Title: Neuroqueering Gender**

Autistic women are much more likely to be misdiagnosed, undiagnosed, and underserved than autistic men, yet our relationship with our identities is much more complicated than simply "underdiagnosis." At least in part because we are not as interested in or responsive to social norms, we are more likely to be transgender, non-binary, and/or gender non-conforming: some of us may not identify as women at all. Furthermore, because autism is a way of being that is uniquely different from allism (i.e., not being autistic), we are capable of experiencing gender in ways that are inherently unrelatable and inaccessible to allistic people. With increasing awareness of and support for the neurodiversity paradigm, which posits that autism is an expression of human biodiversity rather than a pathological condition, and increasing availability of queer and transgender resources, more and more autistic people are able to both access and express queer autistic genders. Working within the neurodiversity paradigm and drawing from queer theory and neuroqueer theory, which suggests that it is possible and even potentially positive to intentionally "queer" one's own neurodivergence, this study seeks to describe the ways in which autistic women and autistic woman-proximal people are neuroqueering gender. I establish the social and historical context in which autistics navigate queer genders and queer neurotypes, and examine existing writing about autistic woman-proximal gender. Given this context, I conduct qualitative interviews to describe how queer / non-cisgender, neurodiversity-oriented, woman-proximal autistics understand, create, and intentionally push the boundaries of our genders and our neurodivergences.

**Student researcher(s): Justin Kramp, Alex Ramirez-G'Arce, Austin Williams**
**Major: Chemistry**
**Research Mentor(s): Dr. Randall Reif**
**Project Title: Quantitative Analysis of Arsenic and Selenium pollution in the Potomac River from Power Plants by UV-Vis spectroscopy and verification by ICP-AES.**

Arsenic and Selenium carry severe health effects on human and fish populations and are strictly controlled by the EPA. Excess selenium and arsenic cause cardiovascular complications and cancer in humans, and mutations, infertility and food source restrictions in fish populations. Coal power plants have gone without oversight of pollution limits for over a decade, with reports indicating discharge levels up to 20-fold higher than legally allowed. To determine the discharge of these metals by power plants, water samples are collected above- and below-stream of the power plant at three depths and analyzed. Arsenic and Selenium can be complexed with VANA dye to absorb light at 350-360nm in UV-Vis spectroscopy. The VANA dye will be made by organic synthesis and characterized spectroscopically. Due to the overlap in wavelength, the Arsenic concentration will be additionally determined using a Gallocyanine complexing agent, absorbing at 630nm. A dilution series of metal standards will be made to create calibration curves to determine total metal concentration from the VANA, and arsenic concentration from the gallocyanine. The concentrations determined by UV-Vis will be verified by ICP-AES to determine which method is more precise by comparing the standard deviations in samples analyzed. Samples are expected to range in concentration from 0.010ppm to 0.040ppm for Arsenic and 0.005ppm to 0.300ppm, where the lower end is the safe drinking water limit and the high end being the median concentration for plants not meeting safe discharge.

**Student researcher(s): Andrew LaMarca**
**Major: Economics**
**Research Mentor(s): Dr. Don Lee**
**Project Title: Rationality and Decision Making In the Origins of Mediterranean Commerce**

Early maritime insurance markets were crucial in the expansion of long-distance sea trade following the commercial revolution. Florence De Roover describes marine insurance as the "brick and mortar" of commerce. Without insurance in the age of pirates and warring states, long-distance trade would have been too risky to be profitable. Today, insurers use vast data banks with probabilities and demographics to deduce robust and fair premiums to charge. In medieval times, however, brokers did not have access to such data. In much riskier age with less information, insurers largely had to rely on experience; rumor; faith; and their own estimations. This study examines the rationality and determinants of premium rates. Data was collected from the Archivo di Stato di Prato. Using modern analytical techniques we find significant and sophisticated underlying patterns in the financial decision making of these medieval merchants.

**Student researcher(s): Olivia Larson**
**Major: Historic Preservation**
**Research Mentor(s): Dr. Lauren McMillan**
**Project Title: Debitage Analysis: Burlington County, New Jersey**

In 2018 an archaeological excavation was conducted in Burlington County, New Jersey which reviled a Middle Archaic to Late Woodland-period site. Analysis of Phase II and III excavations indicate that there are high concentrations of Cuesta Quartzite reduction throughout its occupational period lasting almost 7,000 years. Debitage makes up a large portion of the artifact assemblage so there is a great deal of data to work with. This paper analyzes the debitage by size and form in hopes of identifying the stage of reduction and answer questions about the exploitation of the local material, Cuesta Quartzite, by indigenous groups in comparison to other nearby sites.

**Student researcher(s): Haley Lavach, Haley Garcia, Laura Leonard, Sarah Piper**
**Major: Biology**
**Research Mentor(s): Dr. Parrish Waters**
**Project Title: Analysis of BDNF Expression in the Hippocampus; How Diet and Exercise Affect Spatial Memory and Learning in Mice**

In this experiment we will be analyzing the effects of different diets paired with exercise on memory; mainly focusing on the effects toward the hippocampus and BDNF receptors. The experimental groups we will be comprised of four different combinations of high or low fat diets and be paired with either voluntary exercise or no exercise. There will be four separate groups of mice. Group one consists of four mice who are on a balanced diet with exposure to a running wheel and group two consists of four on a balanced diet who are not exposed to a running wheel. Group 3 had four mice that were subjected to a high fat diet and exposed to a running wheel. The final group, group four consisted of four mice as well and was not exposed to a running wheel but had a high fat diet regiment. The diet and amount of exercise are the variables being changed in the experiment. To test the memory of the mouse, after two weeks of being exposed to their diet and exercise plan, they were forced to complete a Barne's Maze. They completed the maze once a day for four days consecutively every week and the time it took the mouse to complete it each day was recorded; the number of errors per mouse per trial were also measured. It is expected that the mice who are exposed to a running wheel and are on a balanced diet will make fewer errors and complete the maze in the least amount of time each week.

**Student researcher(s): Emily MacIndoe**
**Major: Mathematics**
**Research Mentor(s): Dr. Leo Lee**
**Project Title: Analysis of Deterministic and Stochastic HIV Models**

We apply to Susceptible-Infected-Virus (SIV) model to the Human Immunodeficiency Virus (HIV). First, we give analytical solutions to two simplified versions of the model. The first simplified version includes only the infection rate and the virus production rate. Its analytical solution is given in the form of an implicit equation.

The second simplified model includes the terms in the first model in addition to the infected cell death rate. Its analytical solution is obtained from an iterative method. Next, including all the terms in the system, we apply numerical methods to both the deterministic version (in which constants are assumed to be known exactly) and stochastic version (in which the death rate of the healthy cells is represented by a random variable). Our results give an illustrative picture of HIV in-host population dynamics in the absence of treatment. They also demonstrate how randomness can impact the progression of the disease.

**Student researcher(s): Rachel Mattozzi**
**Major: Biology**
**Research Mentor(s): Dr. April Wynn**
**Project Title: Characterizing Novel Escherichia coli Mutants**

Escherichia coli, commonly known as E. coli, was characterized to determine if Lactose operon mutation were Lac Y mutants or Lac Z mutants. The Lac operon is responsible for producing proteins that transport and breakdown lactose. Mutant characterization was conducted via a beta-galactosidase assay and plasmid complementation assay. The Lac Z protein is responsible for the cleavage of lactose (or the analog o-nitrophenyl-b-d-galactopyranoside that produces a yellow cleavage product). The Lac Y protein is responsible for transporting lactose or (o-nitrophenyl-b-d galactopyranoside) through the plasma membrane into the cell to be cleaved. Adding chloroform to a beta-galactosidase assay can act in the same capacity as the Lac Y protein allowing for the determination of potential Lac Y mutants. Lac Y mutants are characterized when the presence of chloroform is needed for o-nitrophenyl-b-d-galctopyranoside to be cleaved as indicated by a yellow color change. Lac Z mutants are suspected when the addition of chloroform is not sufficient to cleave o-nitrophenyl-b-d-galactopyranoside and there is no color change. The beta-galactosidase assay (utilizing appropriate controls) indicated the mutation was in the Lac Y gene. Transformation with a plasmid (circular extra-chromosomal DNA) containing a functional copy of the Lac Y gene was conducted to see if there was complementation. If the transformation restores the ability to process lactose and o-nitrophenyl-b-d-galactopyranoside after the plasmid was added, therefore becoming phenotypically wildtype (yellow color), there is more evidence for a Lac Y mutation. While transformation as unsuccessful, the beta-galactosidase assay indicates the mutants are Lac Y.

**Student researcher(s): Grace McCauley**
**Major: Women and Gender Studies**
**Research Mentor(s): Dr. Debra Schleef**
**Project Title: Who Rules the School**

The following research is based on the theory of the Glass Escaltor, specifically in public elementary schools. Even though there are far more female teachers than male there are still a considerable amount more male's in administration than females. The thesis of my research was to find if the construct of "masculinity" is valued more than "femininity" when it comes to positions like these. Through interviewing those in administration, current elementary school teachers, future elementary school teachers and surveying UMW College of Education students; I aimed to assess their leadership abilities and see if effects of traditional constructs of "masculinity" and "femininity" occurred. Through the survey questions this takes a small pool of future educators and notes if there is just a lack of women who want to become administrators.

**Student researcher(s): Cayley McGuire, Gemma Spicka-Proffit**
**Major: Biology**
**Research Mentor(s): Dr. April Wynn**
**Project Title: "An Investigation on the Correlation Between Dwarfism and Drought Resistance in Arabidopsis *thaliana* plants"**

As climate change becomes a greater problem, the possibilities of more frequent and more severe droughts are increasingly likely. Past research has shown a correlation between dwarfism and drought resistance in wheat, tomatoes, and Arabidopsis *thaliana*. Three cultivars of Arabidopsis *thaliana* were grown under either drought of standard growing conditions. The three cultivars were Col-0 (wild type), DWF1 (a dwarf caused by a brassinosteroid mutation), and ABA3-1 (a dwarf caused by an abscisic acid mutation). Brassinosteroids and abscisic acid are hormones involved in plant development. Brassinosteroids function in cell elongation and

abscisic acid functions in response to environmental stresses. Growth was determined by tracking plant height. Gene expression of Brassinosteroid and abscisic acid response genes were measured in leaf tissues using qRT-PCR to confirm mutants exhibited reduced hormone response.

**Student researcher(s): Phillip McNeil**
**Major: Biology**
**Research Mentor(s): Dr. Alan Griffith**
**Project Title: The identification of ecological function values of native and non-native tree species on University of Mary Washington Campus using i-Tree eco V6**

The negative effects of non-native species have been heavily documented in journal research articles. The opposite can be said of research into the potential positive effects of non-native species. Data quantifying the benefits from ecological services of non-native plant species in urban environments is lacking. The objective of our project will be to quantify the abundances and ecological services of non-native and native tree species located on University of Mary Washington campus using i-Tree eco V6. Ecological services include: species diversity, carbon and nitrogen sequestration, storm water runoff avoidance, and management costs. The i-Tree analysis will also use tree structural measurements to quantify tree biomass of all species. The structural measurements of trees will include tree height, canopy size, and trunk diameter. Our results are expected to provide a perspective on the potential positive aspects of non-native species for landscape managers on the University of Mary Washington campus.

**Student researcher(s): Andrea L. Moore**
**Major: Environmental Geology**
**Research Mentor(s): Dr. Pamela Grothe**
**Project Title: Constraining the Mid-Holocene ENSO Minimum in the Central Pacific Using Geochemistry of a 5,000-year-old Porites Fossil Coral**

The El Niño-Southern Oscillation (ENSO) is Earth's most significant source of internal, year-to-year climate variability. However, the instrumental sea surface temperature (SST) record from the tropical Pacific is too short to fully validate climate model projections, and therefore, presents challenges in meaningfully forecasting future ENSO behavior under external (i.e., anthropogenic) forcing. Fossil corals from the northern Line Islands – a location geographically-sensitive to ENSO-driven temperature and precipitation changes – have been extensively used to study ENSO variability over the last 7,000 years (e.g., Cobb et al., 2013; McGregor et al., 2013; Grothe et al., in prep). Yet these records do not fully span the mid-Holocene, making it difficult to thoroughly characterize the influence of external (i.e., orbital) forcing on reduced ENSO variability during this time (Karamperidou et al., 2015; Emile-Geay et al., 2016; White et al., 2018). Here, we present a new ~50-year-long, monthly-resolved oxygen isotope ($\delta$18O) record from a Porites spp. fossil coral that grew at Kiritimati (01°58.673' N 157°21.056' W) during the mid-Holocene. Scanning electron microscope (SEM) images show only minor diagenetic alteration, which has been shown to have a negligible impact on coral geochemistry-based climate reconstructions (Sayani et al., 2011). Our new coral $\delta$18O record exhibits clear seasonal cycles and ENSO activity, which we compare to present-day ENSO variability recorded in modern coral records from this site (Evans et al., 1999; Nurhati et al., 2009). We will also discuss ENSO variability recorded by this coral in context of the longer 7,000-year-long coral-based ENSO reconstruction from the Line Islands, and provide additional constrains on the timing of the mid-Holocene ENSO minimum.

**Student researcher(s): Joshua Morris, Chloe Morton and Colin Travis**
**Major: Chemistry**
**Research Mentor(s): Dr. Leanna Giancarlo**
**Project Title: Growth Kinetics of Zinc Oxide Nanoparticles for Use in Sunscreen**

Zinc oxide nanoparticles are transparent in visible light and opaque to UV light which makes them ideal for use in sunscreen. Nanoparticles' absorbance maximum increases with wavelength, or red shifts, with an increase in size; therefore, a method of measuring growth kinetics of a zinc oxide colloid was explored in order to optimize UV blockage. Using UV–vis spectroscopy, the cut-off wavelength was determined and the particle size was estimated by the Effective Mass Model, the Ostwald Ripening model, and the Stokes-Einstein equation. Using these models of colloidal nanoparticle properties, the expected growth kinetics was plotted in

terms of absorbance vs wavelength for a range of aggregation times and compared to the experimental curves. Nanoparticle size was then determined from the observed wavelength maxima. The effect of different parameters in the model such as particle size and refractive index were investigated. We predicted that a gradient of sizes would be required for the optimization of sunscreen in order to achieve broad spectrum protection (from UV wavelengths) due to the changes in wavelength absorbance corresponding to the changes in nanoparticle size.

**Student researcher(s): Lisa Mosser and Katherine Sweeney**
**Major: Business Administration and MBA (respectively)**
**Research Mentor(s): Dr. Alexandra Dunn**
**Project Title: A policy-capturing approach to individuals' decision to accept job offers: The role of support and demographic differences**

The purpose of the pilot study is to determine the cues necessary to formulate a policy-capturing study. The policy capturing study will assess the decision-making processes of job seekers. We are interested in understanding how support during the recruitment process from recruiters, hiring managers, and the organization (i.e., organizational rewards) effects decisions to accept an offer. The pilot study, specifically, helps us determine whether or not the cues used in the study will signal support to study participants. Applicants were asked to imagine that they are interviewing for a job and identify which type of support the cues provide. Additionally, they will be asked to rank the provided cues with regards to which plays a major role in deciding whether or not to accept an offer.

This pilot study aids further research supporting the integration of theories of organizational support and recruiting to examine how demographic differences in decision-making are related to accepting a job offer. The pilot study will help address two research questions: 1) does the likelihood of accepting a job offer differ based on if the applicant perceives the recruiting process as supportive or non-supportive? and 2) are the decision policies(i.e., the utilization of information in the decision-making process) for accepting an offer dependent on age, race, or gender?

**Student researcher(s): Mary Novitsky**
**Major: Art History**
**Research Mentor(s): Dr. Suzie Kim**
**Project Title: Vincent van Gogh's Self Portraits**

This paper analysis the correlation of Vincent van Gogh's mental and physical state with his application and choice of color in his self-portraits. His life before art held a heavy influence over his self-perception throughout his artistic career. Van Gogh could not escape his sense of guilt from failing his family, and constantly felt like a burden on his brother, Theo, who sponsored his artistic endeavors. Through Theo's encouragement and work as an art dealer, van Gogh developed his own artistic style and met other popular artists from his time. His friendships along with his developing mental issues lead to an influx of development in the latter half of his career, when van Gogh delved more into the realm of color. He expressed his current emotional state through his works, through the combination of colors and the application of the paint. His brush strokes and color combinations varied depending on the mood he was evoking. The analysis of his correspondences developments a better understanding of his current mental state at the time of each self-portrait. By analyzing his self-portraits, a direct comparison with his changing view of self is drawn through the comparison of his current mental state. The depiction of self varies depending on the utilization of color and brush stroke, showing the varying intensity of emotions. By developing an understanding of his use of color in representing his current perception of self, the same concepts can be applied to understand his mental state in other works of art.

**Student researcher(s): Joshua Olbert**
**Major: Environmental Geology**
**Research Mentor(s): Dr. Chuck Whipkey**
**Project Title: Heat Loss of UMW Buildings**

The quality and type of windows affect how heat is either retained or lost in buildings. Older buildings may have single pane windows, which are inefficient at retaining heat. Newer buildings typically will have double-pane windows, perhaps argon-filled, that are more energy efficient. In order to determine how efficient a window is at retaining heat, a heat survey may be conducted. The University of Mary Washington campus has many buildings suitable for a comparative study of window heat loss in older and newer buildings. The buildings chosen for this study were George Washington Hall (GW Hall; built in 1939) and the University Convergence Center (UCC; built in 2015). The heat survey used a thermal imaging camera that indicates differences between the inside and outside temperature of the windows, from which heat loss can be calculated. Several windows were examined at each building. From the thermal images it was shown that single-pane GW Hall windows were inefficient at retaining heat as compared to double-pane UCC windows. However, the images also indicated an area of increased heat loss surrounding the UCC windows, while there is much less heat loss at the borders of the GW Hall windows. This result may indicate that details of construction and installation, not just window type, are important in overall heat loss.

**Student researcher(s): Cheyenne Palmo**
**Major: Environmental Science**
**Research Mentor(s): Dr. Pamela Grothe**
**Project Title: Survey of Paired δ18O, δD and Salinity for the Chesapeake Bay and its Major Tributaries: Applications to Regional Paleohydrology**

The Chesapeake Bay region is affected by anthropogenic climate change, particularly from extremes in precipitation events causing large swings in salinity (Najjar et al., 2010). To quantify recent changes in the hydroclimate in this region, we need a longer baseline of natural climate variability beyond the instrumental era. The common eastern oyster, (Crassostrea Virginica), is a promising natural archive of climate change using the geochemistry (δ18Oand Mg/Ca) in its calcite shell (Surge et al., 2001; Surge and Lowmann, 2008). However, the Chesapeake Bay estuary is a complex, partially mixed estuary, complicating the δ18O-salinity relationship, which makes interpreting past reconstructions from this region challenging. In summer of 2018, we took paired measurements of δ18O, δDand salinity of the water along transects of the lower Potomac, Rappahannock, and James Rivers at surface and depth and at spot locations around the shore of the Chesapeake Bay in order to understand the relationship between water salinity, δ18O and δD. Salinity varied by 0.1804 (0.2251) ppt per km at surface (depth) in the Rappahannock River, 0.084 (0.16) ppt per km at surface (depth) in the Potomac River, and 0.3406 (0.387) ppt per km at surface (depth) in the James River. River discharge, a function of regional precipitation, seems to be the largest source of salinity variability. We expect to see linear mixing between river water and ocean water along a local meteoric line between the paired δ18O-δD-water salinity data; however, due to high rainfall variability during the summer of 2018, a disequilibrium in the trend is expected. Paired δ18O-δD-water salinity measurements will allow us to construct a calibration model that provides us with a better understanding of what drives salinity variations in this region, aiding in the interpretation of paleoclimate reconstructions using the geochemistry from the oyster shells.

**Student researcher(s): Kaitlyn Parker**
**Major: Biochemistry**
**Research Mentor(s): Dr. Davis Oldham**
**Project Title: Design and Synthesis of Indazole Sulfonamides as Inhibitors of KasA: A New Approach to Tuberculosis Infection**

Tuberculosis, an infection caused by Mycobacterium tuberculosis (TB), is a leading cause of deaths from infectious disease. Despite many commercially available drugs, TB continues to persist in part due to the rise of drug-resistant bacteria. One of the mechanisms of resistance in TB is its waxy coating, which is synthesized by a complex of enzymes including KasA, the enzyme responsible for M. tuberculosis cell wall creation. Recently, indazole sulfonamides have been shown to inhibit TB growth. To build on these lead compounds, we began to make derivatives. In the first step, 2-amino-5-nitrotoluene was reacted with sodium nitrite in glacial acetic acid to produce 5-nitroindazole. The product was extracted with dichloromethane, washed with saturated sodium carbonate, and dried over magnesium sulfate. A 199.0°C-199.5°C melting range verified the identity of the product as 5-nitroindazole. The 5-nitroindazole then underwent an SN2 reaction with methyl iodide in tetrahydrofuran with NaOH, and a phase-transfer catalyst. The reaction stirred for a week and resulted in two

products shown by another TLC plate. After isolation, the resulting solid was determined by GCMS to be 1-methyl-4-nitro-1H-indazole and 2-methyl-4-nitro-2H-indazole, as expected. From here, the products will be separated to obtain 1-methyl-4-nitro-1H-indazole. Each product will be turned into an indazole sulfonamide which will be tested for antibacterial activity.

**Student researcher(s): Ashley Parkhurst and Emily Matuczinski**
**Major: Biochemistry**
**Research Mentor(s): Dr. Leanna Giancarlo**
**Project Title: Mapping the ultramorphological changes of SPION-induced cell death in Glioblastoma Multiforme**

In the last ten years, there has been little advancement in the treatment of the aggressive brain cancer Glioblastoma Multiforme (GBM). This research describes the synthesis of a superparamagnetic iron oxide (SPION)-based nanotheraputic complex for use in targeting and killing aggressive mesenchymal GBM cells. The average sizes and magnetic properties of the synthesized SPIONs are precisely tailored via a novel time-controlled approach to a previously described electrochemical reaction. Through this synthetic method, the optimal particle size (OPS) where maximal thermal energy is released upon stimulation with an external magnetic field was determined to be 21 nm. The nano-complex was further modified to selectively target GBM cells by adding a heterobifunctional poly(ethylene) glycol polymer cross-linked to TWEAK (a GBM targeting peptide). Transmission electron microscopy and FITC Annexin V/propidium iodide fluorescent probe revealed that cells treated with the synthesized nano-complex showed markers positive for cellular apoptosis. Thus, these nano-complexes hold promise as a potential treatment agent for an otherwise untreatable disease.

**Student researcher(s): Brighton Payne**
**Major: Psychology**
**Research Mentor(s): Drs. Hilary Stebbins and W. David Stahlman**
**Project Title: The Relationship Between Latent Inhibition, Dopamine, and Creativity**

Research has shown that pre-exposure to a stimulus is less likely to reduce subsequent acquisition of a conditioned response (i.e., latent inhibition) in creative individuals. Additionally, both creativity and latent inhibition are correlated with striatal dopamine levels. Research connecting these variables, however, is sparse, and few studies have attempted to examine these correlations in non-clinical human samples. This study aimed to provide a more concrete link between dopaminergic systems, creativity, and latent inhibition in a non-clinical population. The Creative Achievement Questionnaire (Carson, Peterson, & Higgins, 2005), the Epstein (2008) Creative Competencies inventory, and an adaptation of Guilford's Alternative Uses Task (1967) were completed by participants to determine measurements of creativity. Participants also performed a latent inhibition task and electrooculography (EOG) was used to measure spontaneous eyeblink rate which correlates positively with striatal dopamine levels. We predicted that individuals with higher eyeblink rates will show higher scores on creativity measures and reduced latent inhibition compared to those with lower eyeblink rates.

**Student researcher(s): Abigail Phelps**
**Major: Historic Preservation**
**Research Mentor(s): Dr. Lauren McMillan**
**Project Title: Keeping the Tune: Jaw Harps and Colonial Music of the Chesapeake**

Located in Westmoreland County, Virginia, Nomini Plantation (44WM12) was occupied from the mid seventeenth century to the early eighteenth century. The two jaw harps found at Nomini Plantation date to the late 1700s, and are representative of the cultural and physical dependency of the American colonies on England for their musical traditions and exported goods. The jaw harp's role in seventeenth-century music is one that is often overlooked in both period and contemporary sources, but their commonality across sites in Europe and the United States suggest that they were used and discarded frequently. This research explores how these relatively cheap and simple instruments fit into plantation life in the Chesapeake, as well as their place in seventeenth-century music. Jaw harps played a musical role in the hands of their seventeenth-century owners, but today their role is also an instructive one, as some of the only surviving archaeological evidence of music in early colonial Virginia.

**Student researcher(s): Mackenzie Poust**
**Major: Religious Studies**
**Research Mentor(s): Dr. Farhang Rouhani**
**Project Title: A Woman's Place: The Role of Women Within Fundamentalist Interpretations of Islam and the Discourse on Autonomy**

Islamic fundamentalist groups have been the subject of recent discourse across multiple disciplines. Often emphasized is the role that women are given, take for themselves, or simply exist within in groups of this nature. While the position of women in any society changes depending on time and space, the beliefs, actions, and experiences of Muslim fundamentalist women in modern-day South and Southwest Asian societies create for the women new identities through both reviving the traditional and rejecting or reworking the modern. This place, in this time, is transformative for the region, the women, and ultimately, Islam. Fundamentalist interpretations of Islam allow for women to have a unique role, vastly different from their counterparts in more moderate or liberal approaches. Women either accept their position, finding a form of empowerment or attempt to rewrite it through protest, resistance, and reeducation. Their role in groups such as the Taliban of Afghanistan, Al Qaeda, and the Islamic State is affected by either method and, in turn, creates an evolving spectrum of religious expression and understanding as to where "women's places" exist, be that as mothers, wives, sisters, friends, believers, revolutionaries, or conformists. The experiences cannot be categorized in any monolithic terms - the discussion of women's autonomy in their own lives and the decisions surrounding religious belief and practice serve to challenge notions that universalize and essentialize any woman, any Muslim woman, and any Muslim fundamentalist woman across time, space, and belief.

**Student researcher(s): Megan Price**
**Major: Business Administration (Marketing)**
**Research Mentor(s): Dr. Belleh Fontem**
**Project Title: Client Selection for a Risk-Constrained Commodity Option Underwriter facing Poisson Demand**

We consider an expected payoff maximization problem for a risk-sensitive underwriter of an option contract on a commodity with geometric Brownian motion spot price trajectories. Firms hoping to enter into service agreement with the underwriter each face Poisson demands that would be the underwriter's responsibility to satisfy. Subject to a variance risk budget, the underwriter's goal is to select the optimal combination of client firms to privilege with its option contract. We derive the optimal solution algorithm for the variance-constrained maximization problem. Then, we conduct extensive numerical experimentation on real and synthetic data to glean insights regarding how the contract's expected payoff responds to the risk budget and the parameter governing the stochastic evolution of the spot price of oil.

**Student researcher(s): John Pruchnic, Steve Berrios, Zachary Zwierko**
**Major: Computer Science**
**Research Mentor(s): Dr. Ray Scott**
**Project Title: Chemical Equilibrium Visualization**

Chemical Equilibrium Visualization is a web application that allows students to understand the concept of chemical equilibrium. The product has a main interface that users interact with. The main interface contains a seesaw, a sliding fulcrum, and two weights. The weights are on each end of the seesaw. The main interface also contains inputs for the number of products, the number of reactants, and the equilibrium constant. The web application initializes with an unbalanced chemical equation and remains unbalanced until one of two things occur: 1) The user enters the correct balanced equation or 2) The user selects "automatic" mode, which will balance the equation with no further input from the user. Once the equation is balanced, resulting in a leveled seesaw, the user is able to reset the program to its initial configuration. An additional feature, the share functionality, enables a user to share a current interface configuration with another user.

**Student Researcher: Haley Randall**
**Major: Political Science**
**Research Mentor: Dr. Stephen Farnsworth**
**Project Title: Virginia Women and Politics: Party-Line Voting Patterns in the 2016 Presidential Election**

In the 2016 presidential election, 42 per cent of women who voted in the U.S. voted for Trump, even amongst accusations of his disregard for women's interests as well as an option to vote for a female presidential candidate. My main hypothesis was that women vote along party lines, regardless of who the candidates of the party are, and that this was the main determining factor in how women voted in the election as opposed to the characteristics of any specific candidate. In analyzing this data, I hope to better understand why women vote the way they do in elections on all levels, and more specifically to see if the 2016 election was an anomaly for women voters in Virginia or if it followed usual voting trends of women in the state.

To test this, I will use the data collected from the Fall 2017 Virginia Politics Survey. These surveys asked at random different Virginia residents survey questions that related to state and national issues and elections. Bi-variate and multi-variate data analyses in SPSS were used to collect data from these surveys. Voters included in this study voted for Trump in the 2016 Presidential election. The findings showed that while there was a gender gap in the election, the largest determining factor in the voting outcomes of women was in fact their party affiliation.

**Student researcher(s): Devin Rantz, Sam Mackin**
**Major: Biology**
**Research Mentor(s): Dr. Alan Griffith**
**Project Title: Belmont Tree Survey**

Over the past few years the use of Geographic Information System (GIS) mapping technologies on historical and biological sites have risen to become a common technique utilized by biologists and historians alike in the collection of valuable geographic, historic, and biological data. The expansion in the use of GIS mapping technologies on larger more prominent historical and biological sites has become widespread. But, the use of GIS mapping and surveying techniques on smaller culturally significant landscape sites has been narrow in scope, and less common. Our research project has been organized at the request of our client, Beate Ankjaer-Jensen, Cultural Resource Manager of Gari Melchers Home and Studio on the Belmont Estate. Ms. Jensen requested we organize and begin a survey all outdoor artifacts on the cultural site. Our project this year was based on two parts; the construction of a geodatabase that will catalogue the different types of physical features on the estate grounds. These features were organized based on common feature characteristics. The features in our database include trees, shrubs, ground cover (vines), groves, perennial herbaceous plants, and buildings. The second part of the project focused on collecting and recording the size, location, and identity of the trees on the landscaped portion of Belmont Estate. We define the landscaped portion of Belmont Estate as the portions that are mown or harvested, at least biennially. All data are uploaded into the database for our client's to use in the future. We will describe details of our geodatabase and show maps of work completed on our survey of Belmont Estate trees. While our survey has moved forward nicely this year, data collection and artifact cataloguing will continue in the future.

**Student researcher(s): Brynne Reeves and Caitlin Hilland**
**Major: Biology**
**Research Mentor(s): Dr. April Wynn**
**Project Title: Determining the Function of Unknown Polymorphic Alleles in PIN and CHS Genes in Arabidopsis *thaliana***

Arabidopsis *thaliana,* a relative to cabbage, lettuce, and spinach is a widely used model organism in biological research because its entire genome is sequenced. Although sequencing is known, there are many genes and alleles within the genome with an unknown function. Temperature stress has been tested on Arabidopsis numerous times, and it has been established that Arabidopsis acclimates rapidly in response to cold environments. Various responses include changes in the behavior of cell membranes, metabolic pathways, and gene regulation. We have chosen alleles of unknown function, located on genes known to respond to cold environments, to test the impact these alleles may have under cold temperature stress. Arabidopsis thaliana wild type plants will be irreparably damaged when placed in colder temperatures for 48 hours. When polymorphic allele plants are placed in colder temperatures, the unkown alleles chs 1-1, chs 1-2, PIN 1-3, PIN 1-4, and pin1_103E2 will mutate to allow the plants to survive longer in the colder temperatures. These mutations will be genetically expressed and compared to the genetic expression of wild type Arabidopsis to determine a function of these alleles. We believe chs 1-1, chs 1-2, PIN 1-3, PIN 1-4, and pin1_103E2 are involved in auxin

synthesis and efficiency. We expect to see phenotypic differences in root and shoot development between the polymorphic allele plants as compared to wild type plants in colder temperatures, and gene expression to increase in the polymorphic allel plants in response to the cold.

**Student researcher(s): Delaney Resweber**
**Major: Historic Preservation**
**Research Mentor(s): Lauren McMillan**
**Project Title: Stratford Hall Plantation: An Analysis of Yard Space at the West Field and Oval Site**

The Oval Site (44WM80), a mid-18th-century site, is located on the grounds of Stratford Hall Plantation, and likely associated with the 1738 construction of the big house. This site was excavated by the University of Mary Washington Field School between 2006 and 2014. These excavations revealed a complex of four buildings, currently interpreted as an overseer's house, a kitchen/quarter, a slave quarter/outbuilding, and a barn. For this project, I am cataloging, analyzing, and creating distribution maps using plow zone data from around the two possible quarters, combined with previous research by others, to understand site and yard uses. Yard space is commonly associated with enslaved African sites and most of these sites have evidence of swept yards. Trash middens can be used to separate the yard spaces. I will examine the use of the yard space between the two sites to determine the presence of swept yards and trash middens, or the lack thereof. This analysis will aid in identifying the use of these two structures and the sociocultural relationship between the inhabitants of both structures.

**Student researcher(s): Emily Richardson**
**Major: Geology**
**Research Mentor(s): Dr. Pamela Grothe**
**Project Title: Shoreline Preservation on Marlborough Point, Stafford County, Virginia**

A series of soft, sedimentary rock formations crops out along the banks of the Potomac River on Marlborough Point in Stafford, Virginia. These fossil bearing, clay-rich, dark gray sandstone layers are visibly susceptible to a variety of erosion factors, both environmental and human-generated. Both exposed rock layers are identified and placed in local geologic context. Erosion susceptibility information is presented alongside shoreline preservation methods to provide Marlborough Point's residents with a suite of conservation options.

**Student researcher(s): Elyse Ridder**
**Major: Music**
**Research Mentor(s): Dr. Brooks Kuykendall**
**Project Title: Pirating HMS Pinafore: Sousa's 1879 orchestration**

Before he was America's "March King," John Philip Sousa was a jobbing musician like so many others of his generation. From 1876 to 1880, he picked up a series of engagements as director of music for a company in Philadelphia, Pennsylvania managed by John Ford. At the same moment, Gilbert & Sullivan's successful early shows were appearing in pirated productions in the United States. Sousa orchestrated The Sorcerer and HMS Pinafore for Ford's productions.

My project compares Sousa's imaginative product with the original full score, by Gilbert & Sullivan, that was never available to him. Sullivan, who attended a performance of Ford's production in November 1879, "thought the orchestration excellent"—or so Sousa recalled. This unique musical text offers a particularly vivid snapshot of American Pinafore-mania from the hand of someone destined to become a national musical icon.

**Student researcher(s): Grace Rihl and Daniel Arango**
**Major: Grace - Geology; Daniel - Chemistry**
**Research Mentor(s): Drs. Ben Kisila and Leanna Giancarlo**
**Project Title: Sedimentation Rate and Trace Metal Input in Lake Occoquan and Lake Manassas**

Human population growth and subsequent human development is closely linked to contemporary increases in sediment and associated contaminant fluxes to fluvial systems, lakes, reservoirs and coastal zones worldwide. In more urbanized basins the abundance of contamination sources often results in contaminant loadings and water quality declines in neighboring aquatic ecosystems. This study analyzes the environmental evolution of two reservoirs within the Occoquan basin, a sub-watershed of the Chesapeake Bay. Lake Manassas is located

in the upper reaches of the watershed, characterized by mixed land use and cover of mostly forest, residential, and agriculture, whereas Occoquan Reservoir is located in the urbanized lower reach of the basin in the heavily populated suburban zone south of Washington, D.C. Sediment cores from the two lakes were used in 210Pb based sediment accumulation rate analysis. The temporal and spatial distributions of Al, Fe, Cd, As, Se, Pb, Cu, and Zn in the sediments were also examined in sediment cores and grab samples from the two lakes. Watershed GIS-based models were also used in evaluating sediment fluxes and basin soil erosion rates.

Results of 210Pb sediment accumulation rate estimates in Lake Occoquan range from 0.126 g/cm2/yr in the upper reaches to 0.135 g/cm2/yr in the lower reaches with temporal values showing progressive modern increases from 0.125 to 0.154 g/cm2/yr. Lake Manassas had a comparable value of 0.140 g/cm2/yr and a temporal range of 0.120 to 0.157 g/cm2/yr. Watershed modeling results show sediment flux estimates of 0.11ton acre2/yr in the upper mixed land-use areas of the watershed and 0.03 ton acre2/yr in the lower more urban zones of the watershed. Historic watershed modeling resulted in a decrease in estimated erosion over time as a factor of impervious surfaces improved runoff management. Sediment core trace metal data show a correlation between contemporary urban expansion with spikes in trace metal input. Correlations between historical land use, and temporal and spatial trace metals distribution will also be used to evaluate the history of trace metals loading and probable sources in the basin.

**Student researcher(s): Anna Rinko**
**Major: Biology**
**Research Mentor(s): Dr. Parrish Waters**
**Project Title: Patterns of Wheel Running in Bulbectomized Mice**

This work aims to better characterize olfactory bulbectomized (OBX) mice, a premiere model of depression. Characteristics of OBX mice mimic symptoms of human depression and include anhedonia, anxiety, hyperactivity, and hormonal changes. We previously examined anhedonia in this model at the Summer Science Institute (2017) by providing OBX mice with direct access to a running wheel, which mice traditionally find to be a rewarding stimulus. Contrary to our expectations, the OBX mice ran significantly more than controls. We suspected that this may have been due to the hyperactivity present in this model. To differentiate whether this behavior was caused by hyperactivity or a true absence of anhedonia, we utilized a sorter system to limit access to an externally housed running wheel for a period of three weeks. This forced mice to undergo a thirty second wait period in order to access the wheel, allowing us to better determine motivated vs stereotypic behavior. This behavioral data was complimented by an evaluation of the social hierarchy and corticosterone analysis. We found that OBX mice spent statistically significantly less time interacting with the running wheel, had disruptions to their circadian pattern of activity, and had higher fecal corticosterone three weeks into the experiment. However, these differences did not extend to either running speed nor entries into the wheel cage. In fact, cage entries actually increased among OBX mice. Thus we suspect that this lack of wheel engagement is likely the result of the anhedonia present in this model, while the increased cage entries are likely the result of hyperactivity. These findings provide support for both anhedonic and hyperactivity symptoms in this model while also better characterizing how these apply to wheel running behavior. We also provide supporting evidence for circadian disruptions and the presence of higher corticosterone within the model.

**Student researcher(s): Hannah Rothwell**
**Major: Economics/International Affairs**
**Research Mentor(s): Ms. Maysoon Ahmed Al-Sayed**
**Project Title: Analysis of Media Language in Arabic and English News Coverage**

Media portrayal of major news events has the ability to shape the way media consumers view the event. Word choice in particular has an important effect on how an event is perceived by the public. This study analyzes the word choice used to describe the Christchurch Shootings on March 15th, and in particular the differences in word choice between Arabic language and English language news outlets. The top ten most powerful Arabic language and English language news outlets were tracked, and a sample taken from each one. That sample was in the form of a written article or video coverage about the attack on the day that it occurred. In each sample, important key terms were tracked, such as "terrorism", "islamaphobia", and "white nationalist". The words used to describe the event were tracked, as well as words used to describe the perpetrator. Those words were then sorted based on their severity ("gunman" is a less severe term than "murderer" and "attack" is less severe

than "terror attack"). Additional adjectives like "tragic" or "brutal" were also tracked. The word choices for Arabic language news outlets and English language news outlets were then analyzed and compared to one another to highlight differences in the description of the same event. Results are expected to show that subjective opinion or background of journalists can influence their choice of words, and that events can be described differently between Arabic language and English language news outlets. Specifically, Arabic language media is more likely to describe the attack as terrorism than English language media. It can be expected that more powerful word choice can impact the opinions of readers of these news outlets.

**Student researcher(s): Brandon Rozek**
**Major: Computer Science**
**Research Mentor(s): Dr. Ron Zacharski**
**Project Title: QEP: The Q-Value Policy Evaluation Algorithm**

Reinforcement Learning is a collection of algorithms to solve problems within an environment without having any prior knowledge. Due to this lack of knowledge, sample complexity, which is the number of interactions needed to find a solution, is often of high concern. In Reinforcement Learning, there is the concept of a reward that the environment gives out depending on the actions performed. The problem is considered solved when actions performed optimally gather rewards. In recent years, a variety of different algorithms have been proposed falling under the categories of Value-based methods and Policy-based methods. Value-based methods estimate how much reward you can obtain from a given state-action pair and produces a function that chooses the highest pair. Policy-based methods produce a probability distribution over the actions that can be taken and optimize the function directly for maximum reward. As such, Value-based methods produce deterministic policies while Policy-based methods produce probabilistic ones. Empirically, Value-based methods have lower sample complexity than Policy-based methods. However, in decision making not every situation has a best action associated with it. This is mainly due to the fact that real world environments are dynamic in nature and have confounding variables affecting the result. The QEP Algorithm, which I proposed, combines both the Policy-based methods and Value-based methods by changing the Policy's optimization scheme to include value functions. We have shown this approach combines the benefits of both methods so that the sample complexity is kept low while maintaining a stochastic policy.

**Student researcher(s): Anna Ruuskanen**
**Major: Environmental Science - Natural Track**
**Research Mentor(s): Dr. Abbie Tomba**
**Project Title: Identifying Digenetic Trematodes Infecting Elimia *virginica* snails and Cyprinid fish in Eastern Virginia**

Digenetic trematodes are endoparasitic flatworms which can have medical, economic and ecological effects such as causing schistosomiasis in humans, loss of fish harvest, or altering host behavior. All trematodes require two hosts, a mollusk and a vertebrate to complete their life cycle. However, the identity and life cycles of many trematodes that are not economically or medically important are unknown. Identifying larval trematode stages is difficult because they are morphologically cryptic, however molecular techniques can be used to identify larval stages by matching them to adults. Here we try to identify trematodes infecting the freshwater snail Elimia *virginica* and Cyprinid fish (potential definitive hosts) collected from the Rappahannock and Little River in Virginia using cytochrome c oxidase (COI). E. *virginica* and Cyprinids were dissected for parasites, which were then preserved in ethanol. Parasite DNA was extracted, then the COI gene region was amplified using DICE1F and DICE11R primers and sequenced. DNA was extracted from 39 parasites collected from Notropis hudsonius, Cyprinella *analostoma* and E. *virginica* hosts. Of those, 9 sporocysts from E. *virginica*, 2 metacercariae from C. *analostoma*, and 2 metacercariae and 1 adult from N. *hudsonius* were successfully sequenced. Comparisons with known sequences revealed that sporocysts from snails most closely matched trematodes from the families Opecoelidae, Clinostomidae, Diplostomidae, Fasciolidae and Cyathocotylidae. Metacercariae and an adult from fish most closely matched the families of Opecoelidae and Clinostomidae. We found two matches between life stages. Clinostomum *marginatum* was found in both E. *virginica* and as a metacercaria in C. *analostoma*. Also, a genetically identical metacercaria and an unknown Opecoelid adult were found in two different N. *hudsonius*. However, we have not yet matched a sporocyst to an adult. More DNA sequences from different trematode life stages are required for identifying the complete life cycle of a species.

**Student researcher(s): Corinne Rydgren and Benjamin Ahrens**
**Major: Mathematics**
**Research Mentor(s): Dr. Jen Chiang**
**Project Title: Concepts of Surfaces and their Applications Using Mathematica**

The Purpose of this presentation is to explore the behaviors of surfaces and their applications using Mathematica. We first introduce the concepts of surfaces, then we will define and compute the First Fundamental Form, Second Fundamental Form, Gaussian Curvatures, mean curvatures of surfaces, etc. If time permits, we will also provide some applications to geodesics, parallel-translates, etc.

**Student researcher(s): Emily Saldanha**
**Major: Psychology and Women & Gender Studies**
**Research Mentor(s): Dr. Miriam Liss**
**Project Title: How the Language of Choice Affects Perceptions of Women in the Workplace**

In 2017 in the United States, women's median earning was an average of 80% to men's median earnings (The Simple Truth). Women and men graduate with similar experiences in education, work experiences, and economic section but men will still make more in their first year than women (AAUW, 2012). Women are often blamed for making "choices" that would contribute to earning less money than men such as working lower paying jobs, working less hours because of childcare restraints, or not taking promotions that cause relocation. Many people think that these "choices" lead to the significant gap between women's and men's wages. This study is concerned with measuring attitudes about women's choices in regards to participating or abstaining in the workforce. There is research that suggests that when people think that gender inequality is related to people's choices, they are less likely to be concerned about continued gender inequality in the world. In this study, participants received one of two possible versions of the survey. In one version, the scenarios included the word choice, (E.g. Jessica chose not to take the position). In the other, the word choice was not used, (E.g. Jessica did not to take the position). This study explores whether choice discourse affects participant's attitudes about fairness in the workplace and gender roles over all.

**Student researcher(s): Leonid Smorodintsev-Schiller**
**Major: Biology**
**Research Mentor(s): Dr. Debbie Zies**
**Project Title: Investigation into the function of Saccharomyces *cerevisiae* YLR149C and SIR2 genes in the presence of hydrogen peroxide and nicotinamide mononucleotide.**

Genetic stability is crucial for well-being of an organism. Most of the de novo occurring mutations are detrimental, resulting is serious conditions such as type 1 diabetes and sickle cell anemia. Chemicals can affect genetic stability of an organism by altering either one of the intricate biological pathways or directly the DNA structure itself. Hydrogen Peroxide (H2O2) is well known chemical involved in formation of reactive oxygen species that are capable of damaging DNA. Another chemical, nicotinamide mononucleotide (NMN) can be used to generate NADH and NAD+ that can beneficially influence the stability of genetic material. The purpose of this study is to determine if the deletion of two Saccharomyces *cerevisiae* genes, YLR149C and SIR2, have an effect on genomic stability in the presence of hydrogen peroxide alone, or in the presence of both hydrogen peroxide and NMN. YLR149C was chosen because it is an ORFan gene with an unknown function, but has been shown to increase in expression during DNA damage. SIR2 was chosen because of its known role in NAD+ metabolism. Both genes, therefore, may be involved in repair of genetic material. Mutation Rate Assay are being used to determine the frequency of novel mutations associated with the presence of the two chemicals in YLR149C deletion, SIR2 deletion, and wild type yeast strains. The results of these assays will be presented. This investigation will help to determine if SIR2 and YLR149C play in biological pathways active when organisms are exposed to the elevated level of H2O2 and nicotinamide mononucleotide.

**Student researcher(s): Gus Schneider, Alliyah Ramos, Chris Amurrio**
**Major: Biology, Chemistry, Biochemistry**
**Research Mentor(s): Dr. Randall Reif**
**Project Title: Detecting Heavy Metals in Inexpensive Jewelry**

Our goal is to determine what toxic heavy metals are present in certain cheap jewelry and in what concentrations they are found. The specific metals we are interested in detecting are cadmium, lead, antimony, and arsenic as these metals tend be common substitutes used in cheap jewelry and pose the serious health risks. In order to detect and quantify these metals, several samples will be acquired, digested in both a nitric acid and hydrochloric acid solution, gravity filtered, diluted and run through ICP-AES. By also running a series of standard dilutions of the target metal analytes, a calibration curve will be created. The curve will show the linear dynamic range that the digested samples can fall under, and be used to determine the concentrations of the original samples.

**Student researcher(s): Arshuman Sheikh and Arham Zahid**
**Major: Biology**
**Research Mentor(s): Dr. Parrish Waters**
**Project Title: Measuring the effects of food deprivation on leptin levels and social interaction in mice.**

Insufficient food has been an increasing concern in low income families in the US. This shortage of food leads to main concerns in the growth of children in such households. The purpose of this experiment is to investigate how food intake will impact the social behavior in mice. Decrease in food intake leads to decreased levels of Leptin in mice. Increase in Leptin causes an increases aggression in mice. There is no research indicating a correlation between levels of leptin and aggression in mice. Our experiment will see the effects of food deprivation on leptin levels and social behavior, and then observe, if any, correlation between leptin levels and social behavior. 12 mice, each in an individual cage, will be subjected to food deprivation over a period of 12 days. Cages will be grouped in triples and allocated appropriate food percentages (Cages 1-3, 4-6, 7-9, 10-12 with 100%, 75%, 50%, and 25% respectively). Results are expected to show a decrease in food intake causing an increase in aggression in mice. To quantify our results, after 39 hours the mice in the same group will be subjected to an unfamiliar cage. Here we will look at the aggression in each group and compare it to their food intake and analyze the effect of food deprivation on their behavior. We will utilize BORIS software to create an activity budget for all four groups of mice, examining their behavior. We will analyze our results using one-way Anova.

**Student researcher(s): Mary Skinner**
**Major: English**
**Research Mentor(s): Dr. Kate Haffey**
**Project Title: Dismantling Purity Culture: The Representation of Female Sexuality in the Evangelical American South**

Purity culture is a form of religious indoctrination that is focused towards pubescent women. It seeks to stigmatize female sexuality in order to encourage strict abstinence until marriage. Most women are initially exposed to purity culture when they are between the ages of ten to thirteen, but the cultural implications can surround women for their entire lives. Functions Purity Culture can be dangerous in many ways, including promoting rape culture, resulting in sexual dysfunction, and even leading to eating disorders and other mental illnesses. Purity culture seeps into the minds of women and fundamentally alters the way they view themselves, their bodies, and their relationships with men — and because The Church is strictly heteronormative, homosexual desire is never legitimized or discussed except to describe it as sinful. The far-reaching effects of purity culture make it incredibly dangerous to women. Some results of Purity Culture include demonstrating one's commitment to purity by wearing conservative clothing to hide the female body, refraining from engaging in any physical touch with men, and even making explicit pledges of abstinence to one's father. Other common practices within Purity Culture include wearing purity rings to show that one is "married to Jesus," and passing judgement on other women outside of the Culture who may or may not have different beliefs about abstinence and purity. This capstone is a thoughtful discussion of the damaging effects of Purity Culture, and is a critique of the way the American Christian Church represents female sexuality.

**Student researcher(s): Lexandria Stanford**
**Major: American Studies**
**Research Mentor(s): Dr. Krystyn Moon**
**Project Title: "Self-Determination: The Korean Independence Movement and the Korean Community in the United States"**

The Korean Independence Movement was started in 1919 after the March 1st Movement in Korea. Fighting against Japanese rule, the Korean Independence Movement worked to gain Korea's freedom through the idea of self-determination, which came from Woodrow Wilson's Fourteen points. The Independence Movement was able to provide a sense of community and new identity for Koreans who were apart of the diaspora, especially in the United States. This paper looks at the events that would lead to Korea's annexation by Japan, such as the Sino-Japanese war, the Russo-Japanese war, and the official annexation of Korea in 1910. Also within the paper that will be looked at is the March 1st Movement, the influence of self-determination, the Korean Provisional Government and the First Korean Congress, Korean communities in Hawaii and the U.S. mainland, and the United States response to the movement.

**Student researcher(s): Rachel Summers**
**Major: Biology**
**Research Mentor: Dr. Dianne Baker**
**Research Mentor(s):**
**Project Title: Embryonic Development of the Stress Hormone Axis in Two Model Teleost Species**

Glucocorticoid hormones mediate stress responses in all vertebrates, from teleost fishes to mammals. In teleosts the primary glucocorticoid, cortisol, is synthesized by the interrenal gland via a series of enzyme-mediated reactions. Cortisol synthesis in adults is controlled by hormones produced via the hypothalamic-pituitary-interrenal (HPI) axis in response to stressors. The hypothalamic peptide corticotropin-releasing hormone (CRH) stimulates release of the pituitary protein adrenocorticotropin hormone (ACTH), which stimulates interrenal cortisol production. Cortisol exerts its effects on target cells via two types of receptors, the glucocorticoid receptor (GR) and mineralocorticoid receptor (MR). The timing and sequence of events that leads to a functioning HPI axis in developing teleosts are not fully known. To address this gap, we measured the mRNA from genes involved in cortisol synthesis and signaling throughout embryogenesis in two model fishes, the zebrafish (Danio rerio) and Japanese medaka (Oryzias latipes). We isolated RNA from embryos collected at multiple developmental stages in both species, and used qPCR to measure relative mRNA levels of key HPI axis genes, including CRH, steroidogenic acute regulatory protein (StAR), 11b-hydroxysteroid dehydrogenase 2 (hsd2), melanocortin-2-receptor (mc2r) and MR. In zebrafish, MR transcript levels remained fairly constant throughout embryo development, whereas in medaka, MR transcripts increased 10-fold. Zebrafish CRH mRNA doubled from 6 hours post fertilization (hpf) to hatching (48 hpf). However, in medaka, CRH mRNA levels rose over 90-fold from 2 days post fertilization (dpf) to hatch at 8 dpf. In zebrafish, StAR mRNA levels increased 40-fold from 24 hpf to hatch, whereas levels rose only 5-fold in medaka. In conclusion, we found noteworthy differences in mRNA profiles for CRH, MR, and StAR in both species.

**Student researcher(s): Mariam Tekle**
**Major: Biology**
**Research Mentor(s): Dr. Debbie Zies**
**Project Title: Determing the Role of the Sacchromyces cerevisiae Gene, YDL199C, in DNA Repair**

Genomic DNA carries the genetic information in all organisms, therefore it is essential to preserve its integrity. If the genetic information is compromised then mutations can arise, leading to many potential problems, including cancer. All organisms must constantly monitor their DNA for damage and have mechanisms by which they can repair damage. While the main DNA repair genes have been well characterized, there are still likely to be many genes that contribute to successful DNA repair. Our goal is to use budding yeast as a model organism for the identification of novel genes involved in DNA repair. We chose a gene of interest, YDL199C, from a large-scale study conducted by Jaehnig et al (1). The researchers treated wild-type yeast cells with a mutagen, methyl methanesulfonate (MMS) and identified genes that changed in expression. To confirm the result for our gene of interest, we treated wild type strains with MMS over-time and measured target gene expression using qPCR. Results to date refute the original findings. To further investigate the function of our gene, we compared a strain deleted for YDL199C to the wild type strain in budding index, drug sensitivity and mutation rate assays. The budding index results suggest that the deletion strain does not have a cell cycle phenotype. We are currently collecting data from the drug sensitivity and mutation rate assays and will report on our findings.

**Student researcher(s): Katherine Toomey**
**Major: Anthropology**
**Research Mentor(s): Dr. Eric Gable**
**Project Title: Defining Witchcraft and Spirituality in Modern Society**

During the twentieth and into the twenty-first centuries, new spiritual practices of Wiccanism, Neo-Paganism, and New Age belief have emerged in the United States. Though small in size, they have gained increasing prominence as alternatives to traditional beliefs and practices. As interest and numbers grow, these groups will continue to take a more important place in America's religious landscape. Academics, as well as practitioners, are responding by attempting to label and categorize these new belief systems. This raises the question of what, if any, differences exist within new religious movements as a whole, as well as between them and well-established mainstream religions. Through a survey of academic literature on Wiccan, Neo-Pagan, and New Age movements and practices, as well as supplementary anthropological readings on the topics of magic, religion, and mysticism, the question of how to define and categorize these beliefs is considered. Are current definitions of religion and magic adequate to describe the new practices? How can these new practices be defined independently and in relation to each other? Is it useful or accurate to define new religious movements by contrasting them with traditional religious paradigms?

**Student researcher(s): Matthew A. Tovar**
**Major: Biochemistry**
**Research Mentor(s): Dr. Leanna C. Giancarlo**
**Project Title: Synthesis and Application of a Magnetic Nanoparticle Based Nano-complex for Targeted Cell Death in Glioblastoma Multiforme Cells**

In the last ten years, there has been little advancement in the treatment of the aggressive brain cancer Glioblastoma Multiforme (GBM). This research describes the synthesis of a superparamagnetic iron oxide (SPION)-based nanotheraputic complex for use in targeting and killing aggressive mesenchymal GBM cells. The average sizes (and therefore magnetic
properties) of the synthesized SPIONs are precisely tailored via a novel time-controlled approach utilizing a previously described electrochemical reaction. Through this synthetic method, the optimal particle size (OPS) where maximal thermal energy is released upon stimulation with an external magnetic field was determined to be 21 nm. The nano-complex was further modified to selectively target GBM cells by adding a heterobifunctional poly(ethylene) glycol polymer cross-linked to TWEAK (a GBM targeting ligand). Further investigation with both a FITC Annexin V/Propidium Iodide fluorescent probe and transmission electron microscopy showed that cells treated with the synthesized nano-complex showed biochemical and morphological markers positive for cellular apoptosis. Thus, these nano-complexes show promise as a potential treatment agent for an otherwise untreatable disease.

**Student researcher(s): Paola Urlich and Samantha St. John**
**Major: Biology**
**Research Mentor(s): Dr. Rosemary Barra**
**Project Title: The Effect of SC-66 AKT Inhibitor on HCT-116 Colon Cancer Cell Viability**

SC-66 is a known inhibitor of the Akt/MTOR signaling pathway and is also an inhibitor of the GLUT1 membrane transporter, which regulates glucose uptake. This allosteric inhibitor causes Akt to be ubiquitinated, thus preventing the binding of the PH domain to phosphoinositol triphosphate (PIP3), an intermediate in the signaling pathway leading to cell proliferation. Because of this activity, it was predicted that the colon cancer cell line, HCT-116 treated with SC66 would show an increase in apoptotic cell death. In this study, HCT-116 cells were incubated in a 96 well plate for 24 hours with various concentrations of the inhibitor. At the end of the incubation period, a MTT cell viability assay was performed. The preliminary results indicate that SC66 at a concentration of 0.1 μM increased cell viability, which is contrary to the expected results. Higher concentrations of 10 and 25 μM had no effect on cell viability. Further studies are needed to determine if this effect on the HCT-116 cells is mediated by the Akt/MTOR pathway or if another mechanism is responsible for the observed increase in cell viability.

**Student researcher(s): Cat Zwemer**

**Major: Biochemistry**
**Research Mentor(s): Dr. Randall Reif**
**Project Title: The Temporal Dynamics of the Caspase-8 activation in the Extrinsic Process of Apoptosis**

Apoptosis is a process of cell death that occurs within the body. Caspases are a family of enzymes which activate each other to degrade cellular proteins leading to the death of the cell. The steps of apoptosis are well known, however the timing of caspase activity within the cell is not. The purpose of this research is to understand the temporal dynamics of the caspase-8 activation in the extrinsic pathway of apoptosis. Cells are examined by fluorescence microscopy using an affinity microfluidic device and a fluorogenic caspase probe derived from Rhodamine 110. Fluorescence is monitored over a period of 6 hours, indicating the level of caspase activity within the cell. This procedure is conducted for caspase-8 using a IETD2R probe. Caspase-8 activity was shown to start 1.6 hours post-induction lasting 180 minutes. Understanding the timing of caspase activation could be helpful in designing apoptosis-targeted therapies.

**Student researcher(s): Zachary Zwierko**
**Major: Computer Science**
**Research Mentor(s): Dr. Alan Griffith**
**Project Title: Making ArcGIS Mapping Data Accessible to the Visually Impaired**

Persons with disabilities are often unable to experience the internet as other persons experience the internet. For example, online maps, a visual product by nature, pose challenges for the visually impaired. The purpose of this research project is to produce a map that visually impaired users can access using standard screen reading software. ArcGIS (ESRI, Inc.) is one of the most popular software suites used to manage geographic information system (GIS) data and produce graphical maps. The software is quite powerful and offers a wide range of features to those working on GIS projects. An increasingly common use of ArcGIS is to manage mapping databases which are connected to online services that render interactive maps from their data. These maps provide a detailed yet dynamic view of the information contained in the database, thereby affording much control over how it is consumed. An additional benefit is that these map databases become easily accessible to the public without the need for complex mapping software such as ArcGIS installed on their personal computers. My map uses data from a hosted ArcGIS mapping database without sacrificing any functionality or convenience on the part of the database maintainers. At the center of this map is a web application prototype that integrates JavaScript, HTML, and the ArcGIS API. This application renders an existing map database in a standard visual map as well as delivers map information in a format usable by screen reading software like JAWS or ChromeVox. The web application is also implemented in an efficient and maintainable manner which ensures that future integration with larger or more mainstream websites—specifically the UMW website—will be straightforward.

## Acknowledgement

Funding for this program has been generously provided by the Class of 1959 Endowment. The endowment was established in 2009 to express appreciation for the education, personal growth and enjoyment of Mary Washington's unique environment that was provided to members of the Class of 1959. The endowment supports activities such as the Research and Creativity Day Symposium, conferences or seminars that focus on research or improving instructional methods at the University of Mary Washington.


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