



VIRGINIA TECH'S OFFICE of
UNDERGRADUATE
RESEARCH
SUMMER
SYMPOSIUM

Virtual | July 30, 2020 | 10am-3pm

ABSTRACTS



Jill C. Sible, Ph.D.
Associate Vice Provost for
Undergraduate Education,
Professor of Biological Sciences

Welcome

Even in these unprecedented and challenging times, the Summer Undergraduate Research Conference remains a high point of our summer at Virginia Tech. Many students presenting today have spent ten or more weeks immersed in a research project. Summer affords undergraduates the opportunities to dedicate significant time and effort to the planning, execution and analysis of a research project. They have also had the chance to become authentic members of research teams by working with faculty, graduate students, postdoctoral fellows and research staff. This year, that work has been largely remote, and with perhaps a different focus, but it is no less impactful.

Many thanks to all who have mentored undergraduates this summer. Virginia Tech is pleased to offer these summer experiences not only to our own students, but also to undergraduates from all over the country. We hope that you have enjoyed your time working with Virginia Tech research teams, and we appreciate the diversity of ideas and cultures that you have brought to our research programs. Congratulations to all of our presenters!

A very special thank you to Keri Swaby, Nicole Easton, and our peer mentors for their tremendous work in making this summer and symposium happen. We have discovered that this virtual medium has in some ways provided a wider audience for student work and allowed deep exchanges of ideas with our presenters. So please avail yourselves of that opportunity. I am looking forward to my time learning from our summer research students!

My best,

Jill C. Sible, Ph.D.
Associate Vice Provost for Undergraduate Education



Office of Undergraduate Research



Keri Swaby
Director of Undergraduate Research

Welcome to the annual Summer Research Conference at Virginia Tech! This year is a little bit different since we have had to move research and events online. I applaud the students presenting today and their faculty mentors who pivoted quickly and adapted to this uncharted territory. We are extremely excited to welcome 53 presenters from 5 organized research programs and many independent labs, who will give 75 video presentations. Over the course of the past 10 weeks, these undergraduate students from Virginia Tech and across the country have been engaged in a wide variety of projects tackling real world problems in many disciplines. I am extremely humbled by the quality of work on show today and welcome you to enjoy and marvel at the wealth of research that took place remotely this summer.

When COVID-19 hit and we realized that summer operations would not be business as usual, many students lost their summer research opportunities or had their experience move online. Not wanting students to lose an entire summer, we quickly reached out to our key partner in the Library, Amanda MacDonald, and developed a comprehensive training and professional development program that was made available to those students who could conduct research but also those who could not, but who wanted to prepare to engage during the academic year. We successfully adapted our regular in-person programming to online formats, including a special offering of the Library's successful Advanced Research Skills (ARS) training program in which more than 300 students enrolled and professional development activities made possible by the grace, fortitude, and flexibility of presenters and facilitators including Daniel Bird Tobin, Patty Raun, Carrie Kroehler, Dr. Shernita Lee, Dr. Paul Heilker, graduate student Kelsey Reed, and several graduate student and graduate school panelists. Thank you all for sharing your expertise and insights with our summer students.

This summer was not only about research and professional growth. A special thank you to our energetic and creative peer mentors – Hana, Meghan, and Shelley - who had the daunting task of creating a research community virtually! They coordinated many virtual social events including a vast array of fun virtual game nights, wellness check ins, recipe swap, and more. Without these dedicated mentors, this summer would not have been as fun and engaging. Thank you all for your incredibly hard work.

And I want to extend an extra special thank you to Nicole Easton who has been instrumental in organizing OUR activities throughout the summer!

The operations of the OUR would not have been possible without generous financial support from the Fralin Life Science Institute. Thank you!

Researchers, congratulate yourselves on a challenging but productive summer. I hope you have been inspired to continue exploring and growing. Good luck!

Sincerely,
Keri Swaby
Director of Undergraduate Research

SUMMER RESEARCH PROGRAMS AT VT

PROGRAM DIRECTORS

MULTICULTURAL ACADEMIC OPPORTUNITIES PROGRAM (MAOP)

Monica Hunter (MAOP Director) and Amy Ingram

The MAOP Undergraduate Summer Research Internship (SRI) started in Summer 1993, and since then has been a transformative experience for hundreds of students. The purpose of the program is to provide undergraduates from diverse backgrounds an opportunity to conduct research on campus and to educate participants about graduate education. Students from a wide variety of academic disciplines spend ten weeks during the summer (late May - late July/early August) working closely with a faculty mentor in a mentor/protege relationship to design, conduct and present a scholarly research presentation.

Since many SRI participants eventually enroll in graduate school at Virginia Tech or elsewhere, this program has been an especially effective way to invest in and prepare a talented, diverse group of students for enrollment in graduate programs. Previous participants have been very successful in obtaining graduate degrees and in adding to the diversity of their institutions and within their professional fields.

CLAIRE BOOTHE LUCE PROGRAM

Monica Hunter (Director) and Amy Ingram

MAOP is fortunate to receive a generous grant from the Clare Boothe Luce Program to support up to eight female undergraduates with research funding for the summer and following academic year. The goal of the program is to assist in diversifying the fields in the physical sciences and engineering and to encourage women to pursue research careers in those fields. Students in the following disciplines are eligible to participate in the program:

College of Engineering-Aerospace, Chemical, Civil and Environmental, Computer, Computer Science, Electrical, Engineering Science and Mechanics, Industrial and Systems, Materials Science, Mechanical, Mining and Minerals, and Ocean, College of Science-Chemistry, Geosciences, and Physics

NSF/RET SITE: WATERECUBEG (ENGINEERING, ECOLOGY, ENVIRONMENT, + GEOSCIENCES)

Marc Edwards (Civil Environmental Engineering)

This NSF-RET site on WaterECubeG is a collaborative effort among faculty members in the Colleges of Engineering, Science, Natural Resources and Environment, and Agriculture and Life Sciences.

Nineteen teachers (high school and community college) were trained in water research activities during the 6-week programs in summer 2017 and 2018. Eleven teachers are participating in this program in summer 2019. This includes 5 Master Teachers (MTs). The MT program is piloted in summer 2019 to develop an effective strategy to disseminate the work of the Site participants to their peers within and outside SW Virginia. The Site participants work on various interdisciplinary water research projects under the mentorship of VT faculty and graduate students. They also participated in a professional development program including field trips and learning module development activities.

PROGRAM DIRECTORS CONTINUED...

The RET scholars are expected to infuse their research experiences into their courses during the academic year. One key objective of the site is to establish a community of teachers mentored in interdisciplinary water research for support, collaboration, and dissemination of site activities to a larger group of teachers in Virginia. A faculty from Virginia Western Community College is taking lead in the community development work. The Institute for Critical Technology and Applied Science (ICTAS) hosts this site. The site activities are coordinated by the faculty and students in the Learning Enhanced Watershed Assessment System (LEWAS) lab.

NEUTRINO REU

Dr. Camillo Mariani (Department of Physics) and Betty Wilkins (Department of Physics)

Our physics faculty is engaged in a broad spectrum of research within neutrino physics, including electron/neutrino scattering experiments, the search for sterile neutrinos, phenomenology studies, long baseline optimization for DUNE and the study of neutrino spectrum from nuclear reactors and supernovae neutrino experiments and theory.

In this rich intellectual environment, the REU students will have the opportunity to pursue independent and productive activities, guided by an established team of faculty members together with assistant professors and postdocs.

TRANSLATIONAL OBESITY UNDERGRADUATE RESEARCH SCHOLARS (TOUR)

Dr. Deborah Good (Department of Human Nutrition, Foods, and Exercise) and Samantha Harden

The Translational Obesity Undergraduate Research Scholars (TOUR-Scholars) is an NIH Funded research-intensive summer experience, which prepares students for graduate and medical education in translation obesity research. Eleven undergraduate students representing Virginia Tech and three other universities were chosen to participate in the 2019 summer program and are working with 9 different mentors at Virginia Tech, VetMed, and Carillion. In addition to research, students participated in diversity, communications, and career training, including trips to TechLabs, the NIH Clinical Center, and National Library of Medicine in Bethesda Maryland, and Carillion in Roanoke.

VIRGINIA TECH RESEARCH AND EXTENSION EXPERIENTIAL LEARNING PROGRAM: SECURING OUR FOOD (VT-REEL)

Dr. Sasha Marine (Biochemistry) and Caitlin Cridland (Biochemistry)

Virginia Tech's Research and Extension Experiential Learning (VT-REEL) program on Securing Our Food is a research-intensive 10-week summer experience, which engages undergraduate students in translational plant science research via a combination of hands-on laboratory and field-based experiences. VT-REEL fellows spend the first half of the program on-campus, working in molecular plant sciences labs, and spend the second half of the program at Agricultural Research and Extension Centers (AREC), working in applied plant science labs.

Eight undergraduate students from diverse academic institutions across the United States were chosen to participate in the 2019 summer program. Each VT-REEL fellow conducted a translational plant science project under the guidance of two faculty mentors: one on-campus mentor and one AREC-affiliated mentor. Students participating in the program were provided with research stipends, housing and an on-campus meal plan. Funding was obtained through the USDA-NIFA. This program will continue through 2020.

Informational Booths

We invite you to visit and talk with representatives from several graduate programs, from across Virginia Tech's Blacksburg, Roanoke, and National Capital Region campuses.

SCHOOL OF NEUROSCIENCE

MOLECULAR AND CELLULAR BIOLOGY

SIGMA XI - THE SCIENTIFIC RESEARCH HONOR SOCIETY

TRANSLATIONAL BIOLOGY,
MEDICINE, + HEALTH

VT GRADUATE SCHOOL

Abstracts

Nick Angle

Virginia Tech/Physics

Ian Harnett

Virginia Tech/Aerospace

Smallsat Systems Development and Propulsion Test Stand Design

This presentation addresses the work done by Ian Harnett and Nick Angle on Virginia Tech's small satellite projects over the summer of 2020. The four main areas of research were conducted on the Thicksat mission flight board, the development of a backup power distribution board, a deployable antenna system for a WSPRnet satellite, and a small satellite propulsion test stand. These four topic areas incorporate both Virginia Tech's short and long term plans for space accessibility, and as such the projects were inspired by VT's own past missions along with attempting to update our in house capabilities. This was done by analyzing issues with previous satellites and looking to improve not only where Virginia Tech had left off but also other universities. The Thicksat mission's goal is to passively deploy a carbon-fiber solar boom. It's currently scheduled to launch in February of 2021 on NG-15. The backup power distribution board is meant to provide redundancy for future VT satellites and the test stand is designed to provide a reliable and highly accurate method to test a range of small satellite propulsion systems. The WSPRnet satellite is aimed at ionospheric research between 150 and 200km and will require a reliable deployable antenna for weak signal propagation report (WSPR) protocol signals.

Mentor(s): Zach Leffke (Electrical Engineering, VT Hume Center), Dr. Jonathan Black (Aerospace Engineering, Virginia Tech)

Kenny Barnes

Virginia Tech/History

Creating Home – A History of Black Inclusion and Community Building at Virginia Tech

For many, when asked to describe Virginia Tech, their answer is easy, “This is Home”. However, while Virginia Tech has served as a home away from home for thousands of students, many others came to campus to find feelings of isolation and alienation from their peers. Through the examination of oral histories, university newspapers, department newsletters, and other university artifacts, I investigated the barriers that existed between white and Black undergraduate communities at Virginia Tech from 1953 until the early 2000s. Since Irving Peddrew III became the first Black student to enroll at Virginia Tech in 1953, Black students have continually worked to transform Virginia Tech into the Home that they were promised. Initially prohibited from living or eating on campus, and from joining social organizations, Black students were instigators of change, challenging administrative policies and carving out their own spaces and places on campus and in Blacksburg. Continuing through the early 2000s, this narrative provides a broad history of the ways in which students, administrators, and faculty struggled to at first limit, but later welcomed Black students on their campus. Unlike previous works on the integration of Virginia Tech, this project pays particular attention to the paradoxical world that Black students at predominately white institutions face- a constant battle between hypervisibility and invisibly, inclusion and exclusion- with each coming and going as they navigated specific spaces and places.

Mentor(s): Paul Quigley (History Department, Virginia Tech), David Hicks (History, Virginia Tech)

Alexandra Barrett

Virginia Tech/Biomedical Engineering

A Passive Device to Aid Individuals with Cerebral Palsy in the Process of Eating

For individuals with cerebral palsy, eating can prove challenging due to inconsistencies in muscle control. This can lead to difficulty gripping utensils and maintaining controlled movement while picking up food from a table. We developed a passive device that applies damping forces to an eating utensil to allow for controlled movement and reduce the effects of involuntary muscle spasms. The device attaches to a table and consists of a series of links connected by rotary disk dampers. The eating utensil is held with a ball joint, and can be grasped by the wearer's hand. Next steps include collecting data on the damping forces created during typical eating motions. After mechanical analysis, human subject testing will be conducted to determine the effectiveness of the device.

Mentor(s): Dr. Alan Asbeck (Mechanical Engineering)

Matthew Barroso

Georgia Tech/Physics

FSI Analysis

The final state interaction (FSI) describes how an incoming particle interacts with nucleons before exiting the nucleus. Our study is based on experiment E12-14-012 at JLab, which was an electron scattering experiment done on Argon and Titanium nuclei. The purpose of this experiment was to study the spectral function of these nuclei which gives information on the probability of finding nucleons with certain energy and momenta. This is useful for us as it gives us a way to understand neutrino interactions with the nucleus. In neutrino experiments, since the neutrino cannot be detected directly, we can only reconstruct neutrino energy by the final state particles visible energy. Through FSI, the nucleus affects the neutrino energy and thus neutrino oscillation. So with this study, we will calculate the cross section of electron-nucleus scattering with relativistic FSI code and compare the Monte-Carlo with experimental data. The method I used to complete this this summer was running Fortran code to calculate the cross section on different orbitals. Once this was calculated for each orbital, a C program was run to further analyze the data.

Mentor(s): Camillo Mariani (Physics), Libo Jiang (Physics)

Katherine Benza

Clemson University/Biochemistry

VT REEL

Does varying the amount of inositol pyrophosphates affect salt tolerance in *Arabidopsis thaliana*?

Phosphate is an essential macronutrient for plants. It plays a role in the synthesis and structure of certain molecules, as well as in photosynthesis, respiration, and metabolism. Inositol pyrophosphates (PP-InsPs) play a major role in phosphate homeostasis and energy signaling. High salt concentrations in arid and semiarid soils prevent crops from sufficiently using water and from absorbing other essential nutrients. For this project, three mutants, with varying amounts of PP-InsPs, were used to investigate the role of PP-InsPs in the salt stress response of *Arabidopsis thaliana*: a double knockout of *vip1* and *vip2* (X3), a knockdown of *ipk1*, and an overexpressor of the VIP2 kinase domain (VIP2KD OE). I hypothesize that the increased accumulation of phosphate in *ipk1* mutants will increase its salt tolerance compared to WT. On the other hand, the decrease in accumulation of phosphate in X3 and VIP2KD OE plants will decrease the salt tolerance when compared to WT. The plants were grown in soil for 2 weeks before applying a salt treatment. The treatment plants were then bottom watered with 200 mM NaCl to induce a salt stress response while the control group was bottom watered with tap water. The amount of chlorosis, or yellowing of the leaves, and developmental differences were recorded for the mutants and compared to WT. The results will be reported. The results of this research could potentially present a link between phosphate homeostasis and salt stress response in *Arabidopsis thaliana*.

Mentor(s): Dr. Glenda Gillaspay (Biochemistry Department)

Hannah Bonyak

College of William and Mary/Biology

VT REEL

The Effect of High Humidity on Arabidopsis thaliana Plants with Varying Amounts of Inositol Pyrophosphates?

Inositol pyrophosphates, or PP-InsPs, are critical to activating the phosphate starvation response in plants. Under low phosphate (Pi) conditions, plants undergo morphological changes to increase Pi uptake. Increased humidity increases the amount of water available to the plant and the susceptibility of a plant to pathogen infection. The purpose of the study is to observe how an increase in atmospheric and soil moisture affects the growth of mutants of Arabidopsis thaliana altered in their PP-InsP content as compared to wild type (WT) plants. The ipk1 mutant has higher Pi accumulation, while VIP2 Kinase Domain overexpressor (VIP2KD OE) plants have lower Pi accumulation. Mutants lacking both VIP1 and VIP2 (named X3) have only slightly reduced Pi. I hypothesize that increased humidity will increase Pi uptake; the ipk1 mutant may show signs of Pi overaccumulation, VIP2KD OE may show less signs of Pi starvation, and X3 and WT will have increased Pi uptake. Plants were grown for five weeks with a humidity treatment and phenotypic differences in the control and treatment plants were observed and measured. Initial data show that all plants exposed to higher humidity undergo etiolation. VIP2KD OE plants exposed to higher humidity developed more yellow leaves as compared to untreated VIP2KD OE plants. These data suggest that PP-InsPs are involved in plant responses to environmental signals such as humidity.

Mentor(s): Dr. Glenda Gillaspay (Biochemistry Department, Virginia Tech)

Natalie Boyle

Virginia Tech/Cognitive and Behavioral Neuroscience

The Role of Personality Traits in Neurodegenerative Disease

Statement of Research Questions:

Detecting precursors to neurodegenerative diseases (ND) has been identified as key priority given their impact, social, and societal costs in an aging population. More specifically, identifying personality, social, and mental health factors associated with ND risk may guide screening and intervention efforts.

Study Purpose:

To advance understanding of how personality factors are associated with future cognitive difficulties and functioning difficulties, this study investigates how personality traits predict symptoms that may be associated with later NDs, such as having attentional and communication difficulties.

Method:

Participants ($N=547$, ages 18-80, mean=37.954) were recruited via Amazon Mechanical Turk. They were not screened for a mental illness history, but many reported some form of current mental health treatment ($n=115$). Participants completed measures assessing attention and language difficulties, as well as other measures such as the second edition of the Big Five Personality Inventory (BFI-2) and the Expanded Version of the Inventory of Depression and Anxiety Symptoms (IDAS-II). Several multiple regression analyses were conducted to determine associations for personality with attention and language difficulties.

Summary of Results:

Across models examined, the personality trait of conscientiousness, which reflects tendencies toward being organized, efficient, and dutiful, showed the strongest associations of any personality trait with attentional and language difficulties (all associations negative in direction and significant at a $p < .001$ level). These associations warrant further investigation when incorporating long-term longitudinal designs to determine the extent to which deficits in conscientious precede these issues and are a possible ND screening target.

Mentor(s): Kasey Stanton (Psychology Department, Virginia)

Bella Brann

Virginia Tech/Physics

Engineering Faster Domain Wall Motion in Magnetic Nanostrips: A Micromagnetic Study

The motivation for this project is to optimize domain wall mobility in thin magnetic films, in order to achieve faster and more stable transmission of information in next-generation nanoscale computing and communications technologies. The domain wall is a boundary between uniformly magnetized regions in a magnetic material, and the physics of domain walls often governs the operation of magnetic devices. By studying and experimenting with domain wall dynamics, we are able to contribute towards the development of future magnetic memory-storage and logic devices. Using a state of the art micromagnetic simulation program, I simulated domain walls driven by electric current in a conventional single-layer magnetic strip and a novel double-layer (synthetic antiferromagnet) strip, varying parameters such as current density, non-adiabaticity of spin-transfer torque, and damping intensity. In this study, I have found that faster and more stable domain wall motion is achieved in synthetic antiferromagnets due to the suppression of instabilities from vortex formation. These findings represent notable progress in the understanding of domain wall dynamics. Such knowledge is essential in the engineering of rapid wall motion in practical nano-magnetic information technologies.

Mentor(s): Satoru Emori (Physics, Virginia Tech)

Walker Britt

The Pennsylvania State University/Plant Science

VT REEL

Inositol Pyrophosphate and Salt Tolerance in *Arabidopsis thaliana*

Soil salinity is a major abiotic stressor for crop plants. An excess of salt in the soil will cause crop senescence, growth inhibition, and death. The purpose of this research is to determine whether the salt tolerance of *Arabidopsis thaliana* is impacted by mutations in the inositol pyrophosphate (PP-InsP) signaling pathway. PP-InsPs are molecules that allow plants to sense phosphate (P_i), an essential nutrient for plant growth. The existing literature suggests that plants which over accumulate P_i have an increased tolerance to salt stress. For this experiment, three PP-InsP mutant lines (*vip1/vip2* [X3], *ipk1*, and VIP2KD OE) were compared to wild-type (WT) plants. Based on P_i accumulation differences, VIP2KD OE was expected to be less salt-tolerant than WT, *ipk1* more salt-tolerant than WT, and X3 similarly salt-tolerant to WT. For each line, there was a control group, which was watered with unamended tap water, and a treatment group, which was watered with a 100 mM NaCl solution. Plant development was measured using rosette diameter, leaf count, and bolting time. WT and X3 treatment groups have experienced similar, significant reductions in rosette diameter compared to their respective controls. The *ipk1* mutants have experienced a similar, although non-significant, size reduction. In contrast, VIP2KD OE mutants have experienced very little reduction in rosette diameter under treatment. These results do not support the hypothesis and suggest that P_i accumulation is not the lone determinant of salt tolerance in *Arabidopsis*. It is likely that the morphological differences between these three mutant lines also play a role.

Mentor(s): Glenda Gillaspay (Biochemistry Department, Virginia Tech)

Peyton Brock

Virginia Tech/Psychology

The accuracy of adolescent self-ratings on measures of emotional and behavioral problems

Statement of Research Questions

Researchers interested in studying behavioral and mental health issues in adolescence often administer questionnaires to both adolescents and their caregivers to obtain multiple perspectives on issues adolescents may be experiencing, but to what degree do ratings of behavioral and mental health issues from adolescents converge with ratings from their caregivers? Related to this, to what extent can adolescents accurately report their social, emotional, and behavioral issues?

Study Purpose

This study sought to address these questions in a sample of 205 early adolescents (ages 12-14) and their caregivers. Specifically, aims of this study were to determine the degree to which adolescents' reports of their own problem behaviors (e.g., rule breaking, aggression) aligned with those of their caregivers.

Method and Data Analysis

Adolescents rated their problems using the second edition of the Schedule for Nonadaptive and Adaptive Personality (SNAP-2) and caregivers rated their children's problems using the Child Behavior Checklist (CBCL). Both correlational analyses and multiple regression analyses were conducted to examine how adolescent's ratings were associated with their caregiver's ratings.

Summary of Results and Conclusion

Results of these series of analyses suggested that adolescent's self-ratings of problematic behaviors such as rule breaking and aggression were meaningful and positively associated with caregiver ratings of these behaviors, although many of these associations were relatively weak in magnitude. Collectively, these findings suggest that adolescents have some degree of self-awareness and can accurately describe social, emotional, and behavioral issues they may be experiencing.

Mentor(s): Kasey Stanton (Psychology, Virginia Tech)

Samuel Browning

Virginia Tech/Psychology

Variation in Daily Mood States during COVID-19: Assessing the Impact of a Gratitude Letter

Near the end of spring break, Virginia Tech decided to shut down campus in response to the COVID-19 crisis. As a result, all course work was encouraged to be made available online which ultimately swayed students from returning to school. Research at the Center of Applied Behavior Systems (CABS) subsequently came to a halt and additionally the CURE course, offered by CABS, needed modification for online learning. Because CURE was intended to provide experiential learning to undergraduates, transitioning to online learning was inherently problematic. To ameliorate both issues, we assigned a Gratitude Letter, writing a letter to thank someone for a kind deed, due every Wednesday night, to both the CURE students and the Undergraduate Researchers (URs). To investigate the Gratitude Visit's effectiveness we assigned a 15-item Mood Assessment Survey which was to be completed twice a day (once in the morning and once at night). To assess the impact of the gratitude letter, we asked the students who signed up for one or two field study credits complete the Mood Assessment Survey, but they did not write the Gratitude Letter. We collected data, a 10-point Likert scale for 15 mood states, across a span of 34 days from 33 participants (21 in the experimental group and 12 in the control group). The differences between the first (morning) and the second (evening) mood rating will be compared across individuals and between groups.

Mentor(s): E. Scott Geller (Center for Applied Behavior Systems, Virginia Tech)

Victorjose Catalan

Virginia Tech/Wildlife Conservation

MAOP

Reviewing Taxa: Scoping Research Trends of the Effects of Climate Change on Infectious Disease

In scientific research, comprehensive analysis of a specific topic to determine what further research is needed to advance the field is referred to scoping. As an example of a study area in which scoping may be necessary is the topic of anthropogenic climate change. While it is well known that the warming of the globe in recent decades has had and will continue to have great impacts on human and animal health, scoping studies are noticeably lacking in detailing the history of research regarding effects of disease and disease transmission. Thus, we worked to determine the trend of empirical research on climate changes effect on infectious disease through the scoping of three years' worth of research from 2019 to 2017. For the purpose of this review, articles were collected from Web of Science (Clarivate) literary reservoir and screened by at least two researchers, to ensure they met a predefined criterion for inclusion. Through the process of screening 2018 articles it was determined that through understanding the proportion of research separated by taxa, we can better assess which species require more research placed upon them. The goal of this review is to provide a descriptive model of research scoped based on the taxa of interest for each study. In doing so, we hope to outline potential bias in peer reviewed material and highlight the importance the expanding the field to address multiple taxa for their significance and the potential challenges they may face in the future.

Mentor(s): Luis E. Escobar (College of Natural Resources and Environment, Virginia Tech)

Anna Cheema

Virginia Tech/Criminology

Hokie Women of Color

Women of color (especially black women) are often erased from the narrative of general history, since they were never given a platform to speak on. Their intersectional identity as a woman and a person of color gave them twice the hardships to overcome and let their voices be heard and respected. In my project, my goal is to tell the hidden stories of the women of color who were a part of the Virginia Tech community in the past century. Looking at this from a big picture perspective, the ultimate purpose of this study is to showcase the struggles and accomplishments that women of color had to go through and still must go through on the daily. Researching women of color specifically AT Virginia Tech makes it more personal to the students here, showing that there was so much history that had been forgotten by the white counterparts. During my research, I have been scouring oral interviews, using primary sources from The VT Special Collections and previous copies of The Bugle at VT. I organized my thoughts into five different sections: The First Six Black Women as Students, Cultural Safe Houses, Black Women as Essential Workers, The Asian and LatinX Experience, and Celebrating Black Beauty. Through my research, I found that there were many women of color who broke barriers by simply attending the university. I told the stories of women like Carmen Venegas, Yvonne Rohran Tung, Linda Adams, and many more.

Mentor(s): Paul Quigley (History Department, Virginia Tech), David Hicks (History, Virginia Tech)

Mary Elisabeth Cochran

Hollins University/International Studies

The International Exchange of Policing: A cross regional case study of the US and Israel/Palestine

This project looks to examine how policing and other systems of state violence in the US and Israel/Palestine inform and impact each other; how international corporations impact the preservation and expansion of these systems; and lastly, how Foucault's imperial boomerang manifests in both regions. Incorporating theory from sociology, geography, and international relations and pulling from a variety of source types (namely academic journals books, social media, human rights reports and reports from non-profits and newspaper articles) this interdisciplinary project looks to provide a cross regional examination and comparison in the discourse of policing and resistance given the recent murders of George Floyd's murder and Iyad el-Hallaq and the following protests. It is through exchange programs, funded by both pro-israel organizations and government bodies, that the American police have been able to militarize in terms of tactics as quickly as they have in the post-9/11 era. It is through US financial aid and its use by the Israeli government to create contracts with Israeli weapons corporations to produce "non-lethal" and "crowd control" weapons and then sell them abroad to countries including the US that the police have militarized. It is through decades of empire building and/or colonization that the police have been able to make themselves into an integral institution for preserving hegemony in both regions.

Mentor(s): Dr. Jon Bohland (Global Politics and Societies)

Lia Compton
Virginia Tech/Physics

MAOP

Micromagnetic Simulations of Ferromagnetic Resonance in Thin Films

Magnetic films have a wide range of use in technology and damping in these films affects their overall efficiency. Measuring the ferromagnetic resonance helps to quantify these damping effects. In this project, testing for ferromagnetic resonance is accomplished by running simulations that divide a thin film into cells and driving the magnetic moment within each cell. A rapid oscillating magnetic field is introduced to transfer microwave energy to drive the magnetization. The amount of damping can be observed from the oscillating magnetization near the resonance condition. These simulations replicate the results found in experimental efforts and have the potential to simulate for more complicated materials.

Mentor(s): Satoru Emori (Physics, Virginia Tech)

Jonae' Crump

Virginia State University /Psychology

MAOP

The Role of Adolescent and Parent Psychopathology and Emotion Dysregulation in Family Conflict During the COVID-19 Pandemic

Adolescence is characterized by increased autonomy and challenging rules, often resulting in family conflict. The COVID-19 pandemic has likely heightened these experiences since families are practicing social distancing and spending more time at home. Both emotion dysregulation and psychopathology have been previously linked to family conflict, as such, this study examined adolescent and parent psychopathology and emotion dysregulation as predictors of family conflict during the COVID-19 pandemic.

Participants included 25 adolescents aged 11-16 ($M=13.28$; 13 males) and a primary caregiver (100% females; aged 30-64). Well-validated, commonly used measures of psychopathology, emotion dysregulation, and family conflict were used. Multiple regression analyses were run, with all psychopathology and emotion dysregulation variables in one model and age, gender, and family income as covariates.

The regression model accounted for 97% of the variance in family conflict ($R^2=.967$). Adolescent depression and ODD symptoms were significant, large predictors of parent-adolescent conflict ($\beta=1.02$ and $.66$). These measures were significant above and beyond the effects of demographics, parent and adolescent emotional regulation, adolescent anxiety and ADHD symptoms, and parent psychopathology. No demographic variables were predictive of family conflict. Results suggest that interventions targeting symptoms of depression and ODD (e.g., irritability) could lessen family conflict during COVID-19.

Mentor(s): Dr. Rosanna Breaux (Psychology, Virginia Tech)

Kameron Cummings

Virginia Tech/Psychology

MAOP

Experiences with Remote Learning During the COVID-19 Pandemic Among At-Risk Children and Adolescents

Previous research indicates that during times of transition, such as summer breaks, specific students are impacted more than others: males, students in special education, and students from low income families. Considering the shift to remote instruction during COVID-19, students with disabilities are more likely to need help from their parents with organization, telecommunications, and prioritizing academics. The present study explored remote learning experiences among an at-risk sample of youth with mental health and learning disorders.

Participants included primary caregivers ($N = 52$, 92% mothers) and students (56% male) ages 8-16 years. Caregivers completed the Home Adjustment to COVID-19 Scale to assess the impact of COVID-19 on home learning behaviors, home-school communication, and school service use. Linear regressions were run to examine differences in remote learning across students with an IEP/504 plan and based on psychological diagnoses, controlling for gender, age, and income.

Results indicated that parents of youth with an IEP/504 plan had less confidence and more difficulties managing remote learning. Youth with an IEP/504 plan were marginally more likely to have difficulties with remote learning. Youth with ASD engaged in significantly less schoolwork and had parents with marginally less confidence in managing remote learning. Similarly, youth with an internalizing disorder engaged in significantly less direct instruction and schoolwork. Surprisingly, youth with ADHD engaged in marginally more schoolwork. Results suggest youth with IEP/504 plans and psychological disorders are vulnerable in remote learning environments. Schools should provide more support for these at-risk youth during the 2020-2021 school year.

Mentor(s): Rosanna Breaux (Psychology, Virginia Tech)

Senija Davis

Virginia Tech/Animal and Poultry Sciences

MAOP

Technological Methods Applied to Next Generation Sequencing

Data analysis of next generation sequencing is an ever-changing process utilized by researchers to study genetic sequences. While there are several applications in many different scientific disciplines, some modern bioinformatics and epigenetic research have evaluated the genetic mutations in neurological cells that may have harmful effects on organisms. In the case of epigenomics and transcriptomics, techniques such as RNA-seq, scRNA-seq, DNA methylation, and ChIP-seq are all used for identification and analyses. These methods have improved in such a way that enables millions of DNA/RNA fragments to be studied. There is also a computational biology component that uses Linux-compatible operating systems and command line softwares as tools to create pipeline frameworks, making such studies more comprehensible. These technological methods can be applied to medical fields such as the pharmaceutical industry for preventative medicine that target specific cell mutations. We will be specifically studying the process of ChIP-seq in the coming weeks.

Mentor(s): Dr. Hehuang Xie (Department of Biomedical Sciences & Pathobiology, Virginia Tech)

Logan Dickinson

Virginia Tech/Engineering Science and Mechanics - Biomechanics

How Much Angular Offset Is Acceptable To Achieve A Successful 1st MTP Joint Fusion?

First metatarsophalangeal (MTP) joint fusion is a surgical procedure employed to treat severe joint arthritis and pain. A key clinical benchmark for successful 1st MTP joint fusion is the achievement of 60% bony contact between the metatarsal and phalanx following resurfacing, which is dependent on guide wire placement. The objective of this study was to utilize a 3-dimensional geometric model to quantitatively analyze the effect of guide wire placement and subsequent bone resurfacing to facilitate successful fusion of the 1st MTP joint. Specifically, we sought to quantify the limits of guide wire placement which would result in 60% bony contact within the joint.

To analyze the reamed articulating surfaces, the metatarsal was modeled as a convex hemisphere and the phalanx as a concave hemisphere. Thus, the joint interface where contact occurs was a hemisphere of the size of the final reamers used in the procedure. The effect of guide wire placement on the bony contact area of the joint interface was calculated using spherical geometry concepts, specifically Girard's Theorem and the Spherical Law of Cosines [1]. Computation of the non-bony contact area from guide wire misalignment was analyzed using an iterative MATLAB program (MATLAB R2019a, Natick, MA). The maximum individual angular displacement permitting 60% bony contact was $\sim 21.6^\circ$.

In summary, the present study outlines a simple and effective analytical geometric method for quantifying the success of a 1st MTP joint fusion. The results have strong implications towards a potential surgical guide prototype limiting angular displacement for proper guide wire placement.

Mentor(s): Vincent M. Wang (Department of Biomedical Engineering and Mechanics, Virginia Tech), Jennifer S. Wayne (Department of Biomedical Engineering, Virginia Tech)

Fatimatou Diouf

Smith College/Biology

MAOP

The relationship between the female athlete triad and sports-related injuries

Objective The female athlete triad (FAT) has been reported to mainly affect women who practice sports that have a focus on aesthetics as they have various dietary restrictions and intense physical efforts. Preventing sport related injuries is an important component of maintaining physically and mentally well athletes. Consequently, the purpose of this study is to identify whether there is a relationship between the female athlete triad and sports related injuries.

Methods We used discharge data from the Nationwide Emergency Department Sample, Healthcare Cost and Utilization Project, Agency for Healthcare Research and Quality. To examine relationships between the components of the FAT and injury, we used chi-square tests where appropriate. To examine differences in the components of the FAT and injury by age, we used T-Tests. We used a binary logistic regression to look at the combination of variables and their influence on injury.

Results We identified statistically significant differences in bone density between sport type; bone density and age; fatigue and the presence of stress fractures; bone density issues and stress fractures; and nicotine consumption and sport type. When adjusting for all other variables, we found no statistically significant relationship between the components of the FAT and sport injury.

Conclusion The female athlete triad has a negative toll on women's physical well-being as some of its components increase the risks of bone stress injuries. This study also shows that it can result in unhealthy habits like nicotine consumption. Further research could include the mental impacts of FAT on female athletes.

Mentor(s): Charlotte Baker (Epidemiology, Department of Population Health Sciences, Virginia Tech)

Neffisah D'odoo

Virginia Tech/Biomedical Engineering

Design and Development of a Customized Focused Ultrasound System for Investigating Histotripsy Cancer Ablation In Vitro

Histotripsy and nanoparticle-mediated histotripsy (NMH) are non-invasive focused ultrasound ablation methods currently under development for cancer treatment. While prior research has demonstrated the potential of histotripsy and NMH for the treatment of multiple cancer types, there remains a significant need for more fundamental studies investigating these methods at the cellular level. To enable these fundamental studies, this research consists of the design and computational modeling of a custom focused ultrasound transducer and cell culture platform that includes a 3D positioning system to be used in *in vitro* histotripsy and NMH studies. First, four models of potential transducers were made in Autodesk Inventor with transducer geometries that would allow for treating inside 6-well cell culture plates. Second, an acoustic propagation MATLAB model was used to estimate the approximate focal pressure of each of the transducer designs to determine whether the respective designs could achieve the acoustic pressures needed for generating histotripsy (>25 MPa) and NMH (>15 MPa). Based on that information, more adjustments were made to develop an optimized transducer such as alterations to overall geometry to increase depth into individual wells, denser packing of elements, and application of square elements, as opposed to circular, to increase focal pressure. Next steps include creating a CAD model of the entire set-up which will include our optimized transducer integrated with a water tank, cell culture platform, and 3D positioning system to allow for precise targeting inside individual wells. And finally, in the fall, the system will be built and used for initial experiments.

Mentor(s): Eli Vlasisavljevich (Biomedical Engineering and Mechanics, Virginia Tech)

Luke Elder

Roanoke College/Physics

CERN ProtoDUNE Single Phase Cosmic Ray Tagger DAQ

During this REU I worked preparing and commissioning a new C++ framework for the DAQ of the ProtoDUNE Muon Tagger also called the Cosmic Ray Tagger (CRT). The CRT is installed in front and back of the ProtoDUNE Single Phase Time Projection Chamber (TPC) in the CERN neutrino platform and it is used to analyze beam halo and to identify a pure set of muons to be used for calibration purposes. I began by examining all parts of the new DAQ code and identifying how all subroutines are interconnected. Each function within the program was analyzed to understand its purpose and how it works. The main CRT DAQ program was then run using a setup in Robeson Room 1 where there are two USB streams available. One connected to one multi anode photomultiplier readout board (MAPMT) and one to seven MAPMT boards. Initially the code was run using just the USB stream that is connected to one board. After verifying that everything was working properly with one board, the code was run with both USB streams and all eight boards. The data collected by these runs was analyzed to locate any potential problems. When all problems were eliminated, the code was tested with different data acquisition rates. At the conclusion of the project, we were able to successfully run the code with two USB streams and eight total MAPMT boards.

Mentor(s): Camillo Mariani (Physics, Virginia Tech)

Aaron Evans

The University of West Alabama/Environmental Science

Cydney Chambers

Virginia Tech/Forestry

Historical Distribution of Five Tree Species

The objective of our study was to calculate the historic and present-day mingling indices of five mesic, deciduous tree species: basswood (*Tilia americana*), black walnut (*Juglans nigra*), butternut (*Juglans cinerea*), sugar maple (*Acer saccharum*), and sycamore (*Platanus occidentalis*). We were particularly interested in the transitions of the mingling index of butternut because of the 58% mortality rate of this species due to butternut canker. Our historic and present-day data represent before and after the invasion of butternut canker. Our historical data was from Public Land Survey records from the early 1800s and the present-day data was from the USDA Forest Service's Forest Inventory and Analysis data. From these two datasets, we calculated the mingling index for each occurrence of our five target species. The Mingling Index equals 1 when the reference tree and the neighboring tree are different species and equals 0 when the reference tree and the neighboring tree are the same species. Butternut (historical = 0.94, present day = 0.82) and black walnut (historical = 0.86, present day = 0.79) had the highest mingling indices meaning they are more likely to grow next to other species. Basswood (historical = 0.66, present day = 0.51), sugar maple (historical = 0.74, present day = 0.56), and sycamore (historical = 0.55, present day = 0.58) had the lowest mingling indices meaning they are more likely to grow next to its own species. Butternut has not experienced a change in its mingling index in response to butternut canker.

Mentor(s): Dr. Carolyn A. Copenheaver (Forest Resources & Environmental Conservation, Virginia Tech)

Lauren Fryzlewicz

Virginia Tech/Biochemistry

Developing a toxic sugar bait to target local *Ochlerotatus j. japonicus* populations

Mosquitoes transmit multiple pathogens killing about a million people every year. Both males and females must consume sugar meals to obtain carbohydrates used for energy. This behavior has historically been overlooked and most of the research effort has been focused on pathogen-host interactions. The main goals of this project are to first better understand the utilization of a sugar meal under different environmental conditions by male and female mosquitoes, and second to then exploit sugar feeding behaviors to develop a toxic sugar bait (TSB) to limit the populations of a local invasive mosquito, *Ochlerotatus j. japonicus*. A TSB is an insect lure trap that is composed of an attractant odorant, a toxic component, and sugar that the mosquitoes can feed on. TSBs are cost effective, sustainable, environmentally friendly, and can be species specific. To develop our TSB we used field caught mosquitoes in the New River Valley to conduct our assays. Five female and five male mosquitoes were placed in two cages with access to either a toxic sugar solution or a control (sucrose) solution and mortality in each cage was monitored for 96 hours. We observed that the mosquito mortality was higher when they fed on the TSB solution. Once laboratory tests have been completed, we will test out TSB traps in the wild to monitor its effects on the surrounding environment and off target species and to validate its efficacy in nature.

Mentor(s): Chloe Lahondere (Biochemistry, Virginia Tech)

Natasha Gaito

Virginia Tech/Clinical Neuroscience

TOUR

In Silico Analysis of the POMC Promoter-- Role of Methylation in Environmental Triggers of Obesity

Obesity has reached epidemic proportions globally with its prevalence nearly tripling between 1975 and 2016. Although there is data to suggest that the environment and genetics each play a large role in an individual developing a metabolic disorder, such as obesity, there is a missing link between the two. This relationship is thought to be regulated by epigenetic changes, which can mark the DNA in response to environmental differences. The purpose of this study is to better examine these epigenetic modifications, specifically DNA methylation of genes important in appetite, to allow us to better understand the connection between environment and genetics. In the present study, we utilized in silico genomic analysis to characterize the methylation pattern in the promoter region of the POMC gene, which has been implicated in human appetite control and obesity. Phylogenetic analysis was used to analyze the POMC promoter to look for conserved regions across species and characterize transcription factor binding sites within the methylated regions. Transcription factor binding sites for c-MYB, USF, and CREB were identified in the promoter region of POMC. As these sites are methylation sensitive, methylation could lead to reduced POMC expression, characteristic of metabolic disorders such as obesity. Further work is needed to assess differential methylation in these transcription factor binding sites as well as on the phylogeny of these areas of the POMC promoter.

Mentor(s): Dr. Timothy Jarome (Animal and Poultry Science, Virginia Tech)

Jessica Gannon

Virginia Tech/Mechanical Engineering

MAOP

Investigation of the Effects of Pulse Repetition Rate on the Cavitation Probability and Bubble Cloud Behavior for Single Cycle Histotripsy Pulses

Histotripsy is a focused ultrasound ablation method that uses a cavitation “bubble cloud” to non-thermally ablate a targeted tissue, such as a cancerous tumor. Previous work demonstrates that a cavitation cloud can be consistently generated by a single pulse with one high-amplitude negative cycle when that negative amplitude exceeds a pressure threshold of ~25-28MPa. While the previous studies have thoroughly characterized the histotripsy intrinsic threshold for single pulses applied at very low rates (<1 Hz), there is a significant need for studies characterizing the effects of repetition rate on the histotripsy cavitation threshold. In this study, we analyzed the cavitation threshold for 100 pulses to degassed, distilled water at pulse repetition frequencies (PRFs) of 1, 10, 100, and 1000Hz using a 500kHz transducer. High-speed optical imaging and passive cavitation detection (PCD) were used to capture cavitation activity for peak negative pressures ranging from 0-44.3MPa in increments of ~2MPa. Preliminary data showed a decrease in the cavitation threshold with increasing PRF. A comparison of the first pulse data showed well-defined bubble clouds with similar dimensions for all PRFs at pressures from 25-40MPa. For subsequent pulses, results showed less well-defined bubble clouds and substantial peripheral cavitation with increasing PRFs. Ongoing studies are being conducted to complete analysis of the cavitation threshold in degassed water and in agarose tissue phantoms. Together, this work will provide significant insights into the fundamental nature of cavitation nucleation in histotripsy therapy and provide a basis for optimizing pulsing strategies for clinically relevant pulsing rates.

Mentor(s): Dr. Eli Vlaisavljevich (BEAM, Virginia Tech)

Sabrina Ghafoori

University of Virginia/Biology

MAOP

Cardiovascular Pathogenesis in COVID-19

The novel coronavirus disease-2019 (COVID-19), which is caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), was first discovered in Wuhan, China in December 2019. In the past 7 months, COVID-19 has resulted in catastrophic global impact and triggered numerous studies of human clinical trials, pre-clinical animal studies, and in vitro cell culture. Now it is known that patients with COVID-19 often show a series of clinical symptoms, such as fever, cough, sore throat, shortness of breath, diarrhea, and fatigue. Earlier studies found that SARS-CoV-2 mainly targets the respiratory system. By directly interacting with angiotensin-converting enzyme 2 (ACE2) receptors highly expressed in the lung, the viruses enter the epithelial cells of the lung and followed by rapidly replicating, releasing from the damaged cells, inducing severe host immune response (so-called cytokine storm) and eventually leading to the thrombotic lung-induced death. However, emerging evidence indicates that SARS-Cov-2 also affects other organs [e.g., heart, brain, kidney, liver, digestive tract, urogenital system, and blood system], but less attention has been placed on these areas. The present review aims to focus on the effects of SARS-CoV-2 on the cardiovascular system. Specifically, we would like to address (1) Cardiovascular clinical symptoms in COVID-19; (2) Direct (viral attack) and indirect (via immune response) effects of SARS-CoV-2 on cardiac and vascular cells; (3) whether ionic channels expressed in cardiomyocytes act as new receptors to promote virus invasion. We hope that this review will provide valuable information on cardiovascular pathogenesis in COVID-19 to facilitate basic research and clinical treatments.

Mentor(s): Dr. Jia-Qiang He (Department of Biomedical Sciences & Pathobiology, Virginia Tech)

Apurva Goel

University of Washington/Astronomy and Comprehensive Physics

Reactor neutrino detection using crystals

Neutrinos are among the most abundant and interesting particles in the universe. Studying them may help solve many deep cosmological mysteries. Yet, they're very difficult to detect. CEvNS, also known as Coherent-Elastic Neutrino-Nuclear Scattering events, have much larger likelihood for neutrino interactions than non-coherent scattering. This project explores the feasibility of detection of neutrinos produced in nuclear reactors within the CEvNS cross section using optimally designed crystal detectors. Such observation can offer new avenues of fundamental physics research and unique nuclear proliferation safeguards, because neutrino measurements from a reactor flux can be directly linked to its overall status. The overall goals of the project are: to compute signal formation for reactor neutrinos, to understand cosmic ray neutron background signals, to identify the ideal detector properties which enhance the signal and aptly differentiate it from the background, and to explore elemental properties to design optimal crystals for CEvNS event detection from reactor fluxes. The main concept behind crystal detectors is to measure crystal lattice damage tracks resulting from CEvNS nuclear recoil events. The tracks are permanent and allow for entirely passive detectors, much like nuclear emulsion detectors. The length distribution of recoil-tracks contain information directly associated with recoil energies resulting from specific particle interactions. Thus, artificial crystal compounds can be designed to have optimal properties that are well-suited for reactor-neutrino signal detection while minimizing background sources of signal interference. Utilizing Python and Mathematica, preliminary data analysis for a range of crystal compositions show that such design and exploration is feasible.

Mentor(s): Patrick Huber (Department of Physics, Virginia Tech)

Megan Graybill

Salem City Public Schools

Data Science in Agriculture Curriculum Module

Our goal with the Data Science in Agriculture Curriculum Module project is to create an integrated engineering curriculum plan with my core subject area, Computer Science, to be easily implemented by another teacher. The goal for students is to experience a hands-on learning opportunity utilizing the iterative design process, data analysis cycle, and making real world and career connections to the agricultural industry through the lens of Computer Science. The purpose of the project is to provide teachers the support of career connections and “grab and go” integrated Engineering and Computer Science lesson plans by working with industry professionals to create real world experiences within the boundaries of classroom needs. In order to build this curriculum module we have been learning about data science in agriculture, drones application in agriculture and other industries, how to assemble a Raspberry Pi, and performed experiments and a lab simulated water flume. In unison with these experiences and having industry based discussions with our mentors and other professionals we have been able to derive simulated activities within the practicality of a traditional high school classroom setting. Over the course of the next year, and potentially beyond, we intend to build out an entire curricular module reproducible with any industry or career cluster. We plan to partner with CodeVA, a nonprofit in Richmond, Virginia and a leader in Computer Science curriculum development, via Virtual Virginia to revamp this module for online learning.

Mentor(s): Dr. Kang Xia (School of Plant and Environmental Sciences, Virginia Tech), Dr. Rick Clark

Kaylee Greiner

Texas A&M University/Animal Science

Where Does Marbling Come From?

Intramuscular fat (IMF), more commonly known as marbling, is one of the most influential factors in determining the eating quality of meat. Although there has been a considerable amount of research on marbling, many of the driving biological mechanisms that control IMF development remain unknown. An important issue in beef production today is the balance between producing high quality meat at a low cost with limited waste. To accomplish this goal, it is imperative to understand the mechanisms and factors affecting the deposition of IMF, as it is considered the latest developing fat depot in livestock animals. The focus of this literature review is on the origin, growth and development, and genetic factors of IMF in order to identify the current gaps in research. Results from the review indicate that intramuscular fat is believed to originate from specialized mesenchymal progenitor cells that differentiate into intramuscular adipocytes. Second, IMF is a moderately heritable trait. Many studies have been conducted to identify the genes that are associated with differential IMF contents in different breeds. Examples of these genes include diacylglycerol o-acyltransferase 1(DGAT1), fatty acid desaturase 2 (FADS2), and mannose receptor C-type 1 (MRC1). However, the exact biological pathways and key genes that control IMF development and growth in cattle remain unknown. Further research in this field is warranted in order to improve meat quality to impact animal and human health.

Mentor(s): Dr. Honglin Jiang (Animal and Poultry Sciences, Virginia Tech)

Cody Hester

Virginia Tech/Meteorology

MAOP

Soil Microbial Assessment: A New Method

Studying microbial activity in soils is a significant endeavor when assessing soil health. While researchers have developed ways to test soil microbial health and activity, they often lack consistency, especially across different kinds of soil maintenance. This research procedure is to aid in the findings of microbial activity via the chemical compound of Resazurin. Resazurin has been demonstrated to show consistent results for displaying cellular respiration in petri dish experiments in lab settings as well as hyporheic zone studies. Resazurin changes color from blue to pink to colorless, depending upon how much microbial respiration is occurring. This study determines if resazurin is an adequate indicator of soil microbial activity. In this study, different varieties of soil maintenance were used, such as conventional till, no till, till, and grass cover. In the experimentation process, there were different tests conducted to observe what factors would slow or excite the changes of color. The resazurin also changes to a daughter product called resorufin. These studies ranged from solar radiation to pre-wetting the soil before the experiment was conducted. In order to confirm the resazurin as an accurate means of measuring microbial activity, a burst test was used to measure the correlation between the rate of change in the resazurin and microbial respiration. The burst test was conducted via a Soil Microbial Activity Assessment Contraption (SMAAC). The results display evidence of the assumption that resazurin can be an accurate means of confirming microbial respiration in soil, however, other tests should not be excluded from further experiments. The research methods used in this study can be applied as a more cost efficient or supplemental way to measure soil microbial activity.

Mentor(s): Ryan Stewart (School of Plant and Environmental Sciences)

Mya Jackson

Spelman College/English

MAOP

Predictors of Emergency Room and Police Visits for Behavioral Crisis among Youth with ASD

Background;

Youth with autism spectrum disorder (ASD) are at increased risk for experiencing interactions with the criminal justice and medical systems. However, little is known about factors that predict utilization of such services, leading to a gap in our ability to support high-risk youth with ASD. This study examines the demographic and clinical predictors of police and emergency room visits.

Methods;

Youth (N=527, ages 4-21) with ASD participated through the Autism Inpatient Collection, a consortium of inpatient child psychiatry units in the United States. At admission, caregivers reported on youth demographics and trauma history, service utilization (number of police home visits and emergency room (ER) trips for behavioral crises in the last two months), autism symptoms (Social Communication Questionnaire), and comorbid irritability and hyperactivity (Abberant Behavior Checklist).

Results;

In the 2 months before admission, 28% of youth had police come to their home (range=0-15; mean=.58) and 40% had gone to the ER (range=0-6; $M=0.65$). A difference score measured the extent to which youth went to the police more than the ER (police – ER visits). Predictors were examined using t-tests and correlations. For the difference score, girls had significantly more ER visits whereas boys had more police visits. Lower income and abuse history predicted significantly more police and ER visits. Irritability significantly correlated with more ER visits and hyperactivity with more police visits.

Conclusion;

Results identify demographic and clinical predictors of police and ER visits among high-risk youth with ASD. Findings can be used to develop targeted interventions.

Mentor(s): Christina McDonnell (Department of Psychology)

Nicholas Jones

Virginia Tech/Aerospace Engineering

Thermal Modeling of a High-Altitude Balloon Payload

The goal of the research was to develop a simplified thermal model of a high-altitude balloon payload to improve understanding of the effects of environmental factors on the steady state temperature of the payload system at float altitude. The satisfaction of thermal requirements is critical for the proper operation of payloads in the near-space environment where they are subject to the influence of multiple environmental and self-heating loads. Improved understanding of the thermal behavior of a payload through modelling and analysis reduces mission risk and improves payload performance. A literature review of thermal management, modelling, and analysis techniques for high-altitude balloons was conducted, with a focus on the change in Earth IR and albedo loads with cloud coverage during flight. This information was then used to produce a MATLAB script which predicted the steady state temperature of the payload for a range of cloud coverage conditions by applying the Newton-Raphson method and complex differentiation to solve the energy balance equation for the payload. The results were then compared to flight data obtained for the payload configuration, to which they showed good agreement. Future work will focus on improving the fidelity of the simulation through the application of Star-CCM+ to model the thermal behavior of the payload.

Mentor(s): Kevin Schroeder (Hume Center for National Security and Technology)

Jazmin Jones

University of Tennessee, Knoxville/Plant Science

VT REEL

Impact of Excess Copper on Inositol Pyrophosphate Mutants in *Arabidopsis thaliana*

Phosphate (P_i) is a necessary macronutrient for plant growth and development, however, much of the P_i in the soil is unavailable for plant uptake. Copper is a micronutrient essential for plant cellular processes, and is widely used as a fungicide in viticulture. Excess copper can leach into the soil and cause copper toxicity. Inositol pyrophosphates (PP-InsPs) and inositol phosphates (InsPs) are signaling molecules involved with nutrient sensing. The purpose of this project was to determine the impact of excess copper on cellular homeostasis, chlorophyll content, and oxidative stress on PP-InsP mutants and wild type (WT) *Arabidopsis thaliana*. For this experiment, 3 mutants with differing levels of PP-InsPs (*vip1/vip2*, *ipk1* and VIP2KD OE) and WT seedlings were grown under ideal conditions with a dome for a week to create a humid environment for germination. The dome was removed and after two weeks, the copper treatment was started. The plants were either watered (control) or treated with copper every 3-4 days for the remainder of the study. The leaf color and rosette diameter were measured after the third treatment. After the second treatment, there were noticeable size differences between the four genotypes. The *vip1/vip2* mutant and WT in both the control group and the treated group were larger and bright green. The *ipk1* and VIP2KD OE plants showed more stunted growth and some yellowing of the leaves. The mutant genotypes overall are doing more poorly than the control group and are showing increased leaf yellowing and senescence, suggesting decreased chlorophyll content. This study suggests that excess copper produces negative growth impacts, including reduction of chlorophyll content, regardless of the levels of PP-InsPs.

Mentor(s): Dr. Glenda Gillaspay (Biochemistry, Virginia Tech)

Emily Kehoe

Clarkson University/Physics

Supernovae Neutrino Estimation for Present and Future Telescopic Surveys

Most massive stars will end their life with a violent explosion known as a core collapsing supernova. Most of a core collapsing supernova's energy comes from neutrinos. Neutrinos give substantial information about the physics of a supernova. At present, there have only been around 20 neutrinos detected from supernovae, which all originated from SN1987A. To further probe the physics of a supernova and neutrinos, more neutrinos must be detected. However, the next supernova explosion from the Milky Way galaxy may be decades away. Currently, there are programs that are continually looking for supernovae, such as the All Sky Automated Survey for SuperNovae (ASAS-SN), and the Zwicky Transient Facility (ZTF). Data from these on-going surveys was visualized to gauge the importance of several factors. This information was used to estimate the total number of neutrino events that could be detected at the Hyper-Kamiokande (Hyper-K) detector from an energy range of 16-30 MeV. New telescopes are being constructed, such as the Legacy Survey of Space and Time (LSST), that will detect supernovae from further distances, which will increase the number of neutrino events seen. Observation time since the explosion and distance of the supernovae are important factors when determining how many neutrino events can be observed. We have predicted the number of supernovae LSST will detect over a range of distances with the hopes of determining the best range of time and distance to find neutrinos.

Mentor(s): Shunsaku Horiuchi (Physics)

Jiwoo Kim

Virginia Tech/Biochemistry

MAOP

Role of inositol pyrophosphates (PP-InsPs) phosphatase SIW14 in plant genetics and physiology

When inorganic-phosphate (P_i) availability in the soil is low, plants upregulate P_i starvation response (PSR) genes to maintain P_i -homeostasis. Recent evidence shows that inositol pyrophosphates (PP-InsPs), energy-rich molecules that have seven and eight phosphate groups (InsP₇ and InsP₈), aid in PSR gene regulation. InsP₈ levels are controlled by conserved enzymes that add or remove P_i from its precursors. In yeast, the PP-InsPs phosphatase Siw14 removes P_i from 5-position of the PP-InsPs ring. Yeast Siw14 loss-of-function mutants (*siw14*Δ) have higher amounts of PP-InsPs compared to the Wild-Type (WT). While plants also have SIW14 and it is suggested to bind and hydrolyze PP-InsPs, this enzyme has yet to be characterized *in planta*. This project aims to characterize plant SIW14 in three ways. First, we studied the genetic impacts of SIW14 on plant growth in *Arabidopsis thaliana* through overexpressing (SIW14 OE) and disrupting (*siw14*-) the *SIW14* gene. Notably, *siw14*- mutants have elevated shoot growth compared to the WT. To further characterize SIW14 substrate specificity, we used computational homology modeling to analyze the binding pocket of SIW14. Lastly, we investigated if there are genes that overlap between yeast environment-stress-response (ESR) system and plant PSR in which PP-InsPs act as signaling molecule in both systems to determine if yeast ESR response is conserved in *A. thaliana*. While further study is required, *A. thaliana* does not appear to have conserved ESR response compared to yeast. Characterization of SIW14 will allow us to further understand the role of PP-InsPs in plant genetics and physiology.

Mentor(s): Dr. Glenda Gillaspay (Biochemistry, Virginia Tech)

Larry Luster

Hampton University/Chemical Engineering

MAOP

3D-Printed Monolithic Contactors with Novel Composition for CO₂ and Diesel Particulate Filtration

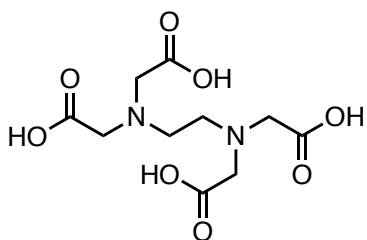
Effective and efficient air filtration systems are necessary for the health and safety of workers in various industries. Due to the diversity of operational environments and target adsorbates for filtration systems, an adaptable and versatile filter manufacturing approach is desirable. Relevant literature indicates that monolithic contactors provide promising alternatives to traditional packed bed filtration systems. The monolith geometry is advantageous because its parallel gas flow channels offer decreased pressure drop and increased contact area for gas exchange. Most importantly, this geometry is fabricable using Fused Filament Fabrication—an Additive Manufacturing (AM) method that employs molten polymer filament as the print feed. In this work, we propose a novel AM method for fabricating CO₂ and diesel particulate air filters using adsorbent-filled polymer filaments. First, a comparison study of different monolith fabrication and characterization experiments is presented. An experimental procedure for monolith fabrication is then proposed. Two adsorbent fillers commonly used in packed bed air filters have been identified as viable candidates for CO₂ and diesel particulate filtration respectively: zeolite ($M_{2/n}OAl_2O_3 \cdot xSiO_2 \cdot yH_2O$) and tialite (Al_2TiO_5). These fillers will be compounded in high weight percentages (>30%) into filaments with polymer binders to produce monoliths with high channel densities. Permanent and semi-permanent binders will be used to produce monoliths with physical properties suitable for the systems in which the filters will be deployed. Based on the reviewed literature, we hypothesize that porous monoliths that demonstrate comparable adsorption capacity, faster adsorption rate, and decreased pressure drop compared to packed bed filtration systems will be successfully created.

Mentor(s): Dr. Michael Bortner (Chemical Engineering)

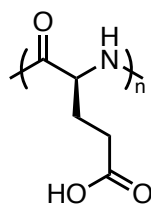
Designing materials for capturing Rare-Earth Elements: Effect of polymer structure

Rare-earth element (REEs: La-Lu, Y, and Sc) contamination of wastewater is a key environmental concern. Additionally, many REEs are valuable materials themselves, thus, REE recovery from environmental wastewaters can be a sustainable process for REE production. REEs are critical components for innovations in green technologies, therefore more effective techniques for the extraction and purification of REEs are in ever-increasing demand. Metal-chelating polymers have great potential in these applications due to their low cost and high affinity for target elements. While previous research has focused on specific ligands attached to polymers, little is known about the effect of polymer structure itself on metal chelation.

We synthesized poly(L-glutamic acid), a material previously reported to be an effective metal chelator, and elucidated the thermodynamics of binding using isothermal titration calorimetry (ITC) to gain insight into the structure-metal binding relationship of this material. ITC enables the direct measurement of the binding affinity (K_a), enthalpy changes (ΔH), and stoichiometry (N) of the interactions between macromolecules and metal ions in solution. We then used ITC to measure the thermodynamics of REE binding to ethylenediaminetetraacetic acid, a small molecule that has a similar structure as poly(L-glutamic acid). By elucidating the thermodynamic profile of each molecule, we have gained insight into this polymer's properties as a metal chelator.



Ethylenediaminetetraacetic acid



Poly(L-glutamic acid)

Mentor(s): Michael Schulz (Chemistry, Virginia Tech)

Hinza Malik

Hollins University/Psychology

Implicit & Explicit Attitude Study

Mental illness stigma is the #1 barrier to mental health treatment despite an increase in mental health literacy. This study aims to measure implicit mental health stigma based on reaction time. Implicit measures have been used in the past to assess racial and other types of prejudice. Previous studies have used words such as 'depression' or 'schizophrenia' paired with adjectives in an IAT (Implicit Association Test). However, they do not measure attitudes toward individuals with 'mental illness' rather, they measure associations to the 'illnesses' themselves which is subtly different. This study tests the IAT and seeks to compare levels of implicit stigma to various explicit stigma measures e.g., social distance, behavioral intentions, emotional reactions, etc. The research sample will include Hollins undergraduate students and participants recruited through online platforms (M Turk, Prolific) to include non-college-students. This will help diversify the sample and allow comparison between implicit and explicit stigma levels across cultures and generational cohorts. Another objective of this study is to find the causal beliefs about OCD, Phobias, and BED, that have not been previously assessed. Moreover, previous studies have shown a discrepancy between perceived 'public' stigma and personal stigma. Therefore, this study seeks to measure the perceived 'peer group' stigma to analyze any difference due to a change in the reference group and compare it with personal stigma.

Mentor(s): Dr. Caroline Mann (Psychology Department, Hollins University)

Christian McAuliffe

Hampton University/Chemical Engineering

MAOP

The effect of process parameters on the tensile properties of PLA and ABS parts generated using fused filament fabrication (FFF)

Fused filament fabrication (FFF) is the process by which filaments of molten thermoplastic are deposited in layers, guided by a computer-aided design (CAD) model. The purpose of this analysis is to determine the extent to which FFF process parameters affect the tensile properties of parts made from polylactic acid (PLA) and acrylonitrile butadiene styrene (ABS). To determine the influence of the FFF parameters, an analysis of variance (ANOVA) test was conducted on a collection of data from existing literature, followed by t-tests to determine the individual parameter contribution. Due to the diversity of testing methods in the literature, the data was first standardized into the following factors: nozzle diameter, infill percentage, nozzle temperature, bed temperature, printing speed, build orientation, layer thickness and raster angle. The data was then imported into the statistical analysis software R to perform the ANOVA test. Extensive literature results highlight the influence of raster angle and build orientation on the properties of FFF parts. Therefore, t-tests were performed on those factors which have not been as extensively studied: nozzle temperature, bed temperature and print speed. Through statistical analysis of the findings of a significant number of papers on the FFF process, the nature of the relationship between process parameters and the tensile properties of printed parts may be better understood, leading to more optimized parts with greater functionality.

Mentor(s): Dr. Michael Bortner (Chemical Engineering)

Lindsey McClain

Virginia Tech/Human Nutrition, Foods, and Exercise (Dietetics)

How Rurality Impacts Availability and Affordability of Healthy Foods in SNAP-Authorized Retail Locations

Disparities in food access have been reported based on rurality. To explore these disparities, the availability and affordability of healthy foods in areas with varying rurality was the focus of this project. Supplemental Nutrition Assistance Program (SNAP)-Authorized retail environments across Virginia, North Carolina, Louisiana, and Mississippi were included in the analysis of availability and affordability of healthy foods. Food availability and price was evaluated for each retail location by trained auditors using the Market Basket Assessment Tool (MBAT). Each retail location was classified according to degree of urbanization and proximity to metro area using USDA Rural-Urban Continuum Codes (RUCC). No significant differences were found between total MBAT score by RUCC for the total sample (p -value = 0.947), indicating there may not be differences in food availability (one construct of food access) based on rurality. While there were not significant differences in availability across RUCC, it is noteworthy that the average MBAT score for all retail locations measured was only a 20.2 on the measured range 0-40 (higher number indicating greater availability of healthy foods). Affordability data (i.e., price of common goods across store type [traditional grocery vs convenience retail]) are currently being analyzed. Future steps in this research should include the continued assessment of more SNAP-authorized retail locations using the MBAT, as limitations to this project included small sample sizes and clusters of data in specific regions, as opposed to evenly distributed data points across states.

Mentor(s): Valisa Hedrick (HNFE, Virginia Tech), Sarah Misyak (HNFE, Virginia Tech)

Spencer Mendola

University of Mary Washington/ACS-Chemistry

MAOP

Physical-Chemical-Biological Property Estimation of SARS-Like Drug Molecules by Machine Learning

Estimation of physico-chemical-biological properties of compounds is a significant problem in engineering and science fields. Currently there are various methods for estimating such properties, for example: by thermodynamics (e.g. group contributions), statistics, or computational chemistry. While there are pluses and minuses of each method, this project considers machine learning (ML) which employs fast evolving data-centric ideas. Current methods for health-related drug development include biological cytotoxicity assays and physical property estimation by mathematical/computational formulas. Recently, treating patients infected with the unbridled 'Coronavirus Disease 2019' (COVID-19) has become imperative. The proposed machine learning model can predict nine physico-chemical-biological properties of respiratory illness drugs.

As samples to the ML network, 76 different respiratory drugs are employed. Each sample's values were standardized and fed into the network as inputs. The results of the computational modeling for three properties, namely, the base dissociation constant (pKa), lipophilicity partition coefficient (logP), and molecular polarizability, gave average r-squared values of 0.79 (+/- 16%), 0.66 (+/- 13%), and 0.75 (+/- 12%) based on the project trials. Based on these results, the proposed approach is judged to be very promising in producing a good interpolative and predictive model. Future efforts along these lines could involve incorporating a larger dataset for better modeling outcomes.

This model may be employed in discovering drugs for treating COVID-19 by inverse modeling. Desirable target values for a drug's physical/toxicological properties would be achievable by user-selection of molecular fragment quantities. A conformation would be derived from the empirical formula which would precede synthesis in the lab.

Mentor(s): Dr. Luke Achenie (Chemical Engineering)

Kassidy Mieses

Hunter College/Developmental Psychology

Parental Mental Health, Stress, and Self-Efficacy among Black and Latinx Families with Youth with ASD

Background;

Families who have children with autism spectrum disorder (ASD) often present with elevated levels of parental stress and mental health difficulties, which may influence the overall family environment, parental well-being and relationship with their children, and their children's behavior. However, little research has considered parental stress and mental health among Black and Latinx families with children with ASD, as racial/ethnic identity has historically been rarely considered in ASD research. Therefore, this study examines differences in parental stress and mental health in Black and Latinx families.

Methods;

Participants were 527 youth (ages 4-21) with ASD from the Autism Inpatient Collection, a consortium of inpatient psychiatry units in the United States, who entered an inpatient treatment program for severe emotional or behavioral concerns. At program admission, mothers and fathers reported on whether they had depression or anxiety and completed measures of parenting stress (Parenting Stress Index-Short Form) and efficacy (Difficult Behavior Self-Efficacy Scale). Chi-square and independent samples t-tests were used to examine group differences.

Results;

Of the entire sample, 57 families identified as Black and 26 identified as Latinx. Regarding mental health, Black fathers had lower rates of depression and anxiety than fathers who did not identify as Black. Latinx mothers reported higher rates of depression. In parenting outcomes, Black families reported higher rates of self-efficacy while Latinx families reported higher parental stress.

Conclusions;

Results advance our understanding of parenting in Black and Latinx families of children with ASD. Culturally-sensitive services are needed to support minority families of children with ASD.

Mentor(s): Dr. Christina McDonnell (Department of Psychology)

Natalie Najman

Smith College/Psychology

Broader Autism Phenotype Traits: Associations with Parenting Style and Other Symptoms

Research Question:

Parents of children with autism exhibit higher levels of subclinical traits related to autism compared to parents without a child diagnosed with autism. These subclinical traits are referred to as the broad autism phenotype (BAP), which consists of traits such as aloofness, pragmatic language difficulties, and rigidity. However, it remains unclear how these BAP traits are related to caregiving behaviors and experiencing other mental health symptoms.

Study Purpose:

To address this issue, this research examined how BAP traits were associated with positive and negative caregiving behaviors. Furthermore, this research investigated the extent to which parents with BAP traits were likely to report elevated levels of other symptoms such as depression.

Methods and Description of Analyses:

138 individuals reporting having a child between the ages of 6-18 completed measures assessing BAP traits. Participants also completed measures such as the Alabama Parenting Questionnaire (APQ) and the Expanded Inventory for Depression and Anxiety Scale (IDAS-II). Correlational and multiple regression were conducted to examine how BAP scores were associated with other variables.

Results Summary and Conclusions:

Different BAP scores were negatively correlated with positive parenting strategies. Furthermore, based on the results of the multiple regression analyses, BAP pragmatic language difficulties appeared to be the most strongly associated with depressed mood and negative parenting behaviors of any of the BAP traits. Overall, our results suggest that BAP traits are meaningfully associated with other symptoms and caregiving difficulties, which can inform future research and parenting intervention efforts.

Mentor(s): Kasey Stanton (Psychology)

Renee Napoliello

The College of William and Mary/Biology

VT REEL

The Effect of Genetic Modification of the Phosphate Starvation Response in *Arabidopsis thaliana* on Response to Excess Iron

Phosphate is a critical macronutrient in plants. With insufficient phosphate, the plant initiates the phosphate starvation response, or PSR, to increase phosphate uptake. Inositol pyrophosphates, or PP-InsPs, are used by plants to sense low phosphate in soil and activate the PSR. Under low phosphate conditions, plants exhibit excessive uptake of iron, symptoms of iron toxicity, and increased transcription of genes related to iron homeostasis and toxicity. The aim of this study is to examine if genetically modifying *Arabidopsis thaliana* to alter levels of PP-InsPs, and thus its phosphate starvation response, also alters resilience to excess iron. Three mutants, *vip1/vip2* (X3), *ipk1*, and VIP2KD OE, were genetically modified to affect genes responsible for the production of certain PP-InsPs. The hypothesis is that the three mutants will experience significantly more impaired growth compared to wild type (WT). They were planted, 8 pots per phenotype, alongside WT under grow lights. Treatment plants were treated with iron EDTA every 2-3 days. Rosette diameter and number of leaves were measured. Observations related to other aspects of phenotype such as leaf color were also taken. The three mutants, treatment and control, exhibited significantly smaller rosette diameter than the WT. The mutants also exhibited other phenotypes, such as yellowing of leaves, compared to WT. The treated mutants exhibited reduced growth phenotypes compared to their control counterparts, particularly in the VIP2KD OE plants. This study not only validates previous research that modifying the *Arabidopsis* phosphate starvation response affects plant growth, but also suggests that such modification may also affect the plant's response to excess iron.

Mentor(s): Dr. Glenda Gillaspay (Biochemistry Department, Virginia Tech)

Linh Nguyen

Virginia Tech/Computational Modeling and Data Analytics

Steven Campbell

Virginia Tech/Computer Engineering

Caroline Spruell

Virginia Tech/Computational Modeling and Data Analytics

Adrian Baron-Hyppolite

Morehouse College/Computer Science

Investigating the You Only Look Once (YOLO) Deep Learning Algorithm for Wireless Spectrum Sensing

The YOLO deep learning algorithm has been shown to work extremely well in traditional image classification and segmentation problems. In this undergraduate research project, we investigate the benefits and detriments of using this well known approach in the area of wireless spectrum sensing applications such as signal detection, signal estimation, and signal classification.

Mentor(s): Chris Headley (Electrical and Computer Engineering)

Brian Odenwald

Blacksburg HS/Mathematics Education

RET

Incorporating STEM Skills and Water Engineering into Standardized Mathematics Curriculum

The goal of this project is to develop lesson modules related to water engineering concepts that can be implemented in mathematics classes. This series of hands-on activities is designed to develop STEM skills while also teaching mathematical concepts required by curriculum frameworks. Demonstrating the relevance of mathematics to real world applications is a long-term goal as we expand to other areas. Building this series of lesson modules has been research-based and reliant on a combination of professional development in engineering and data science, consultation with faculty, and partnerships with VT and Virginia Western Community College (VWCC). Initially, our focus was on using fluid dynamics simulations to learn about water flow fundamentals and develop fully online modules that teachers can use. Then, we used the rectangular open channel flume at VWCC to conduct experiments, collect data, and analyze the results with the intention of creating a hands-on learning experience for students. This collaborative effort has yielded a series of innovative learning modules centered on data collection and analysis. Module 1 studies the relationship between flow speed and velocity in fluids and module 2 studies the relationship between viscosity and velocity. They cover mathematical topics such as linear, exponential, and logarithmic functions, inverses, and line of best fit, as well as concepts related to fluid dynamics such as flow rate, viscosity, velocity, and density. Module 3 studies the hydraulic jump in an open channel, emphasizing data collection, analysis, and graphical representation as part of the scientific process.

Mentor(s): Dr. Kang Xia (School of Plant and Environmental Sciences / NSF - RET), Dr. Rick Clark

Helen Oker

Virginia Tech/Biochemistry

The Physical Activity Guidelines for Americans: A Pragmatic Exploration of Online Dissemination, Delivery, and Training During COVID-19

As a response to coronavirus and limited in-person contact, I worked on 3 projects to explore physical activity promotion through the dissemination, delivery, and training of the Physical Activity Guidelines for Americans (PAGA) online. For the former, 134 grey literature sources were identified as top 10 hits of various search engines with strategic search terms (e.g., 'exercise AND older adult OR elderly'). I have coded 43 of these sources and preliminarily found that while they offer tailored advice for older adults, most do not cite the PAGA. Secondly, after a 6-hour Zoom training I was eligible to deliver a strength training program, LIFT (Lifelong Improvements through Fitness Together). Through process evaluation, autoethnographic field notes, and participant tracking, it was identified that the group-based strategies need adaptation and that video/audio use by participants facilitates discussion. The third part of my research was PACE, an online training series (9 direct contact hours and 9 mastery experience assignments) for Extension agents to build capacity to implement physical activity interventions. PACE is offered in two states to 86 health educators and preliminary data show that live attendance is 72.1(+5.8) agents each week. There is an assumption that programs can transition directly into a virtual space but there is more research to be done to maximize the use of group-based strategies online based on the differences in formats, resources, and common users.

Mentor(s): Samantha Harden (HNFE, Virginia Tech)

Nathan Otto

Virginia Tech/Biochemistry

MAOP

Unlocking the secrets of cellular size control: Investigating the role of cyclin B translation

Growing and dividing cells keep protein concentrations in a narrow range, which is critical for them to remain healthy. But there are exceptions. One such exception is cyclin B. Its concentration increases with cell size, an effect known as size-scaling. Cyclin B is a highly conserved protein required for cells to progress through cell division, and its ability to increase in concentration with cell size may allow it to act as a size regulator. According to this model, cells divide when a certain cyclin B concentration, and therefore cell size, has been reached. What allows cyclin B concentration to scale with cell size is unknown, but recent results exclude transcriptional regulation. I am therefore exploring whether translational regulation plays a role. Cyclin B possesses an unusually long 5' UTR (untranslated region), a region of the mRNA often involved in translational control. To determine if the 5' UTR influences cyclin B size-scaling, I am creating cyclin B mutants in *S. pombe* with the 5' UTR deleted, altered, or replaced with those of other, non-size-scaling genes. I will use live-cell fluorescent microscopy to determine any effects on cyclin B concentration scaling. If I find a significant effect, I will search for regulatory motifs and continue with targeted mutations to reveal the underlying mechanisms of cyclin B translational regulation. This will further our understanding of cyclin B's role in coupling cell size with cell cycle progression.

Mentor(s): Silke Hauf (Biological Sciences, Virginia Tech), Jessie Rogers (Biological Sciences)

Lauren Provinsal

Virginia Tech/Human Nutrition, Foods, and Exercise

TOUR

An Assessment of U.S. Government Progress to Implement the Lancet Commission Recommendations to Address the Global Syndemic Drivers of Undernutrition, Obesity and Climate Change

Background: Released in January 2019, the Lancet Commission Report on The Global Syndemic identified obesity, undernutrition, and climate change as having common drivers that could be mitigated with synergistic actions to achieve planetary and human health. An evidence review was conducted to assess the United States (U.S.) government progress to implement four Lancet recommendations to address subsidies, food labelling, advocacy, and business sustainability models.

Methods: The National Academy of Medicine's LEAD (locate, evaluate and assemble evidence to inform decisions) framework was used to conduct a comprehensive evidence review (February 1, 2019 to June 30, 2020) to evaluate and assess (i.e., no, limited, moderate, or extensive) progress for four Lancet recommendations that mitigate the Syndemic.

Results: No progress was made to redirect funds from subsidies contributing to the Syndemic. Limited progress was made to update food labelling regulations to increase consumer awareness; increase support for community coalitions to advocate for policies; or incentivize businesses to shift their focus from short-term profit to more sustainable outcomes.

Conclusions: Further U.S. government actions to mitigate drivers include redirect funding to support sustainable food systems and environments in future budget reports and the 2023 Farm Bill; define and implement food system sustainability; and enact legislation to achieve human and planetary health that align with the United Nations 2030 Sustainable Development Goals.

Mentor(s): Vivica Kraak, PhD, RDN (Human Nutrition, Foods, and Exercise)

Steven Salazar

Virginia Tech/Engineering Science and Mechanics

MAOP

Experimental Methods for Quantifying the Mechanical Properties of Mouse Bone

Osteoporosis is a bone disease characterized by the body's inability to create enough bone which results in weaker, more brittle bones causing many people affected by the disease to be at an increased risk of bone fracture. Mouse models are extensively used as pre-clinical models of bone fragility and disorders to understand the mechanisms of bone remodeling and adaptation to assess therapeutic treatments. Specifically, these models facilitate the investigation of genetic influences on bone structure and function. The two main experimental methods explored in this project are 3-point bending for mechanical testing and micro computed tomography (micro-CT) for imaging the bone before fracture.

In this project we design experimental approaches for geometric and biomechanical phenotyping of murine bone. A micro-CT machine will be used to image the span length of the mouse femur where fracture is expected to occur. These cross-sectional images can then be used to determine geometric properties such as the cortical area, polar moment of inertia, and a variety of other mechanical outcomes like fracture mode. A 3-point bending test will be performed with support fixtures designed for small beam-like structures like the 5mm span length of the mouse bone. The experiment will test more specific mechanical properties like the stress-strain relationship, yield strength, and modulus of elasticity. These methods provide an experimental foundation which can be applied to quantify the aforementioned properties from various genetically modified mice.

Mentor(s): Dr. Vincent Wang (Department of Biomedical Engineering and Mechanics)

Cat Schumacher

Virginia Tech/Political Science

MAOP

How Geographic Location and Climate Change Impact the Prevalence of Malaria, Zika and Dengue Fever

Malaria, Zika and Dengue fever are vector borne diseases transmitted to humans from the bite of mosquitos, *Aedes aegypti*, *Aedes albopictus* and *Anopheles*. These diseases cause illnesses, such as fevers, rashes, muscle pain, and in serious cases of Malaria and Dengue fever, hospitalization and death. As the temperature increases every year due to climate change, the risk of these diseases increases because mosquitos favor warm, humid and tropical environments, and there is concern about their geographic spread throughout the world. Reviewing the literature from 2017-2019, I focused on the studied location and used sources such as World Clim, Center for Disease Control (CDC) and the World Health Organization (WHO) to analyze how geographic location and climate change impact the prevalence of these mosquito vector borne diseases. After analyzing the data, I anticipate finding that geographic location and climate change impact the prevalence of these diseases, and as the climate changes, case numbers will increase. To account for this, more literature should be written informing the scientific community and others of the danger that Malaria, Zika and Dengue fever pose to populations living in these geographic locations, as well as populations that could be impacted by the diseases and the spread of the mosquitos as the climate increases.

Mentor(s): Professor Escobar (Virginia Tech, College of Natural Resources and Environment), Paige (Victoria) Van de Vuurst, (Virginia Tech, College of Natural Resources and Environment)

Rose Stanphill

Virginia Tech/Aerospace Engineering

Moog PTU Research Study

The goal of my project was to learn how the Moog Pan Tilt Unit (PTU) was designed, and to better understand how the ground station at Hume operates. The Moog PTU is the turning mechanism for the telescope, and its implementation of the telescope required this piece. The majority of my study was spent at Space@VT, where I learned about the electrical engineering, programming, and troubleshooting that went into the development of the Moog PTU. While this project faced some setbacks in March due to COVID, I better understand hexadecimal numerals and Python commands specific to the unit as a result of my study. I also became informed of the CubeSAT project that occurred last semester, and was involved in the troubleshooting process of communicating with the satellite.

Mentor(s): Zachary Leffke (Aerospace and Ocean Systems Lab)

Chloe Tenenbaum

Virginia Tech/Biomedical Engineering

TOUR

The Missing Biomarkers of Inflammatory Bowel Disease: Identification of Possible Missense Variants in the Noncanonical NF- κ B Signaling Pathway

The noncanonical nuclear factor kappa B (NF- κ B) pathway has been linked to Inflammatory Bowel Disease (IBD), which is commonly associated with obesity. NF- κ B is a subset of proteins that control the transcription of genes associated with inflammation. When dysregulated, this increased inflammation leads to conditions like IBD. The nuclear factor-kappa B inducing kinase (NIK) is a crucial regulator in noncanonical signaling and required for further activation of this pathway. Upon activation, signaling is responsible for long-term, specific immune responses that are more tightly regulated than the well-researched canonical NF- κ B pathway. Single nucleotide polymorphisms (SNPs) variants are responsible for altering NIK's function, impairing its ability to bind with TNF ligands at the activation site and phosphorylate IKKa. While some variants have been linked to NIK deficiency, little is known about the hundreds of other variants in the activation site of NIK, which could possibly lead to diseases. We predict that these variant SNPs correlate with IBD and alter noncanonical NF- κ B signaling leading to disease development. Here, we identify missense variants that are predicted to negatively affect the activator NIK and its function, using the NCBI dSNP database to find missense SNPs. Further, we use PROVEAN to predict whether the variants change protein function. Our results indicate missense variants that are likely to have clinical significance and should be tested in future studies. If there is clinical significance, we will identify variants that can potentially be used as biomarkers, as well as targets for IBD treatment in the highly-affected obese population.

Mentor(s): Deborah J. Good (HNFE, Virginia Tech), Irving C. Allen

Gabrielle Troia

Virginia Tech/Geosciences, Geophysics concentration

Initiating a New Baseline of Vertical Land Motions in the Chesapeake Bay

The Chesapeake Bay (CB) is a sea-level rise hotspot along the North American Atlantic coast, partly due to rapid land subsidence. Many previous studies have measured vertical land motions (VLM) in the area, but find contradicting results. This study aims to (1) provide a new baseline of VLM for the CB area over a five-year period using annual campaign-style Global Positioning System (GPS) measurements and (2) elucidate geologic and anthropogenic drivers. Here, we present methods and outcomes of the first campaign (October 2019) that collected initial epoch GPS observations. Surveyors successfully collected data from 53 geodetic benchmarks. Raw binary files were collected and converted to RINEX files. Logsheets completed by surveyors describing the setup, equipment, and observation period for each benchmark were incorporated into RINEX headers to provide complete metadata. All data is being quality checked using the open-source program Teqc. On average, of the 45 stations whose data have been quality checked, 89.61 hours of usable data were collected per station, each RINEX file contains 5,528 cycle slips, and multipath values are 0.65 and 0.49. RINEX files will be archived for open-access at the NSF geodesy facility UNAVCO to abide by FAIR data principles. GPS data will be processed using GAMIT-GLOBK for millimeter-precise positions and velocities. Implications will yield a more accurate understanding of anthropogenically-linked sea-level rise in the CB.

Mentor(s): Dr. D. Sarah Stamps (Geosciences)

Geneva Waynick

Hollins University/Biology

The influence of nutritional composition of infant formulas on the growth of commensal and opportunistic pathogens in the oral cavity.

The oral microbiome is a complex community of microorganisms that can both reflect and greatly influence the health of the human host. A number of diseases are associated with dysbiotic oral microflora in infants and children, including dental (e.g. dental caries, gingivitis, and periodontal disease), and gastrointestinal diseases (e.g. pediatric appendicitis, celiac disease, and pediatric inflammatory bowel disease). The oral microbiome is acquired primarily through exposure to various microorganisms present within the environment during parturition and after birth. A variety of factors can influence the composition of the oral microbial community in infants, including gestation length, mode of delivery, feeding method, and diet. This study focuses on the effects of diet on the growth of commensal bacteria (*Lactobacillus plantarum* and *Streptococcus sanguinis*) and opportunistic pathogens (*Staphylococcus aureus* and *Streptococcus mutans*) commonly found in the oral cavity of infants. A culture-dependent model will be utilized to test the effects of different brands and types of commercially available powdered infant formulas on the growth of the commensals and opportunistic pathogens. The growth of the commensals and opportunistic pathogens will be assessed by measuring metabolic byproducts, consumption of sugars, and pH levels. Based on the existing literature, it is expected that those formulas containing higher amounts of readily metabolized sugars will produce more favorable

Mentor(s): Dr. Mary Jane Carmichael (Departments of Biology and Environmental Studies, Hollins University)

Marquay Williams

Norfolk State University/Biology

VT REEL

How does low soil pH impact *Arabidopsis thaliana* mutants with altered inositol pyrophosphates?

As the human population increases, the demand for food production is increasing. 30% of the world's ice-free land is acidic, and approximately 12% of crops are cultivated on acidic soils. Soil acidification involves a decrease in pH, which can cause decreased seed germination, reduced root growth, and impaired plant height. In addition, low soil pH also influences factors such as soil availability, nutrient leaching, and soil structure. Soil macronutrients such as phosphate are more available at a range of pH of 5.5-8.0 (mildly acidic). Inositol pyrophosphate (PP-InsP) signaling molecules are involved in phosphate sensing and homeostasis in plants. The purpose of this research is to identify how different *Arabidopsis thaliana* mutants with altered inositol pyrophosphate (PP-InsP) levels respond to reduced soil pH. For this experiment, 0.1g/1L aluminum sulfate was applied to *Arabidopsis thaliana* mutants, including a VIP2 kinase domain overexpressor (VIP2KD OE), *ipk1* mutants, *vip1/vip2* (X3) mutants, and wildtype (WT). Aluminum sulfate was used because it is widely used in horticultural crops to reduce soil pH. Differences in plant phenotypes were observed. Plants treated with aluminum sulfate are producing leaves, bolting, and growing at faster rates as compared to the non-treated plants. These results suggest that the aluminum sulfate is not having a negative effect on soil pH. In addition, published transcriptomics datasets were analyzed to identify crosstalk between phosphate and low soil pH. Data from this analysis suggest that PP-InsPs may impact plant responses to pH by up-regulating certain genes.

Mentor(s): Dr. Glenda Gillaspay (Biochemistry Department, Virginia Tech)

Madison Wittmer

Virginia Tech/Geosciences

Studying Coastal Hazards in Cascadia Using a Sediment Core

The Cascadia subduction zone off the coast of Oregon and Washington has not felt a significant earthquake since the year 1700. The only clues of Cascadia's earthquake capabilities lie in the geologic record. By observing earthquakes in Alaska and Chile, researchers have found a cycle of slow uplift and rapid subsidence. This is evident in marsh sediments as it correlates to changing environment such as a tidal flat to a high marsh and back represented by both differing grainsizes and microfossil assemblages. For this research project, I have been allowed by Tina Dura's research team to work on a core collected from Nestucca Bay, Oregon. Thus far I have made visual observations and run a test of grainsize. My results show peat overlaid by mud with a sharp contact between which is consistent with an earthquake event and tsunami deposit. I have also made microscope slides and am currently working on identifying diatoms in the core. I expect to see more brackish or freshwater varieties being replaced by a marine-dominated assemblage across the contact. They will provide a more precise measurement of the amount of subsidence. With miles of coastline being studied by many teams, this single core is but a tiny piece of data. Yet this same type of data is being used in models of Cascadia to help many populated areas prepare for the next large earthquake.

Mentor(s): Dr. Tina Dura (Geosciences, Virginia Tech)

Emma Woolsey

Virginia Tech/General Engineering

Traversability Segmentation

The main goal of my research project is to assess the traversability of a region's terrain from available data, like overhead imagery, so a search and rescue team can determine the fastest route to a search location. In consultation with others, I created a function that weighs four terrain properties affecting traversability: steepness, roughness, hardness, and obstructedness. To compute numerical values for these properties, I began by exploring available data and software. My aim was to develop or adapt a program that can "semantically segment" an image into regions according to their traversability. I investigated the utility of YOLOv3 in Python, a classification algorithm that uses deep learning, and other image processing tools available in OpenCV. When investigating the uses of YOLOv3, I initially relied on commonly used image sets. When I began considering aerial imagery, however, I determined that YOLOv3 is not suitable for my task and turned to more conventional methods for image segmentation like clustering, SLIC, and thresholding. In studying the use of color-based image segmentation for overhead images of the Rocky Mountains, I have discovered that the HSV colorspace allows greater segmentation contrast than the RGB colorspace. In my future work, I will use these segmented images, along with additional data as required, to determine the parameter values needed to compute the traversability measure. I can then semantically label image segments as "not traversable," "moderately traversable," and "easily traversable." Lastly, I will validate the semantic segmentation method using more aerial images and traversability data.

Mentor(s): Dr. Doyle (Hume Center, Virginia Tech)

Mya Wright

Mount Holyoke College/Psychology

MAOP

Gender, Narcissism, and Personality: The intersectionality that affect narrative rating on narcissistic and vulnerable narcissistic individuals

This research was conducted to explore the roles that gender, narcissism, and personality have on how narcissistic traits are perceived in others. Typically, men exhibit higher levels of narcissism and are viewed more positively as leaders compared to females. However, it is unclear how a person's own traits and gender identity influence how they perceive narcissism in others. The purpose of this research is to further understand how one's own personality traits, and specifically one's own agreeableness (i.e., being kind, caring) predict perceptions of narcissism in others. This research also examines the extent to which the gender of the perceiver and target (i.e., someone who is narcissistic) influences how narcissistic traits in others are perceived. We recruited 375 participants (174 females, 201 males) online via Amazon Mechanical Turk. The average age was 39.1 years, and a vast majority of participants identified as White/Caucasian (73.3%). Participants complete surveys assessing their own personality traits and views toward a series of individuals described as narcissistic in vignettes (e.g., as arrogant, callous). Notably, participants' own levels of agreeableness predicted how sympathetic they were toward individuals described in the vignettes, regardless of the vignette's gender. However, vignettes with female gender were rated as significantly more likeable than male vignettes. Male participants also rated the vignette subjects as significantly less likeable than female participants. Collectively, these results suggest that individuals' gender and traits meaningfully influence how they perceive narcissistic traits in others.

Mentor(s): Kasey Stanton (Psychology Department)

Nathaniel Wright

Virginia Tech/Aerospace Engineering

Virginia Data Cube Implementation of the Fire Susceptibility Index

This presentation demonstrates the first implementation of the Fire Susceptibility Index (FSI) on the Virginia Data Cube. The FSI was developed by Dasgupta et al. (2006) and Unruh (2014). The Data Cube is an Open Source Geospatial Data Management and Analysis Software project. It was designed to enable government, academia, and industry access to data and analysis by utilizing technologies such as cloud computing, machine learning, and advanced analytics to make data-driven decisions. Tools such as a Jupyter Notebook are used to import, analyze, and visualize results. The FSI uses Landsat 8 satellite data, a U.S. Earth observing satellite, to analyze wildfire risk on a 30 m scale. Multiple data sources, including the National Land Cover Database, and the National Fuel Moisture Database were fused with the remote sensing data to calculate the FSI and prepare it for meaningful visualization. The initial verification and validation (V&V) of the model has shown promising results; the model has correctly identified high levels of risk based on historic drought levels. The results of this project are twofold: 1) It explores the capabilities of the Data Cube and offers insight into the user environment as the Data Cube continues developing, and 2) it implements a wildfire risk model using only remote sensing data, which provides a more comprehensive view of fire risk. Future goals of this program include expanding the data available on the Data Cube and additional V&V of the FSI.

Mentor(s): Leon Harding (Hume Center)

Rose Zheng

College of William and Mary/Biology

MAOP

Livestock and avermectins in Sub-Saharan Africa: a review of the impacts on productivity and documentation of resistance.

Avermectins are a group of macrocyclic lactone endectocides used in veterinary medicine to treat gastrointestinal helminths and parasitic insects. There is interest in using avermectins in livestock as a vector control tool for the mosquitoes important in transmission of human malaria in Sub-Saharan Africa (SSA); several field trials are currently underway. In order to perform an economic analysis of these interventions, a better understanding of the potential impacts across both human and animal health sectors is needed. A restricted systematic review was performed to summarize the effects of avermectins on livestock productivity and the presence of avermectin resistance in endo and ectoparasites of veterinary importance in SSA. A total of 583 unique journal articles were identified using key search terms in three databases: Agriculture, Life, and Natural Sciences Databases from ProQuest, CAB Abstracts, and Scopus. Fifteen articles met the criteria for inclusion. All studies documenting impacts of avermectins on productivity (n = 10) were performed using ivermectin in beef cattle. Generally, these showed a positive significant effect on growth rates over time. Resistance to avermectins was documented in three articles. Considering the extensive literature documenting resistance to avermectins in other areas of the world, our findings may reflect a paucity of studies on the subject in SSA. The authors conclude that additional research is needed to quantify the potential benefits and challenges to the livestock sector of using avermectins for malaria control, including within swine and dairy cattle, across different production systems, and in a variety of ecological settings.

Mentor(s): Cassidy Rist (Department of Population Health Sciences)