2024

Dennis Dean Undergraduate Research & Creative Scholarship Conference

Office of Undergraduate Research / April 26, 2024

research.undergraduate.vt.edu/symposium

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Welcome

Jill C. Sible, Ph.D.

Associate Vice Provost for Undergraduate Education
Professor of Biological Sciences

Welcome to Virginia Tech's 2024 Spring Undergraduate Research and Creative Scholarship Symposium. This event celebrates the creative and scholarly accomplishments of undergraduate students' campus- wide. Our program reflects the quality and diversity of undergraduate research at Virginia Tech. Many of the projects are the result of collaborations among several students.

Undergraduate research is recognized as one of the high impact practices in undergraduate education. Students who participate in undergraduate research are more likely to thrive and persist in their education. They become co-creators of knowledge, makers of objects that are useful and beautiful. At the heart and soul of these projects are collaborations between undergraduates and their mentors. Many thanks to the faculty, graduate students, and others who commit to these scholarly endeavors with undergraduate students. Undergraduate researchers are well positioned with the skills needed to enter the workforce or continue their education upon graduation.

This year, students who have participated in service learning and study abroad will be among our presenters. Thank you for sharing what you have learned about our communities, both local and global.

We also welcome 13 local high school students who have engaged in research under the mentorship of Virginia Tech and Radford Univeristy faculty. We hope that your experience has sparked a passion for research and a lifetime of curiosity.

Many thanks to Keri Swaby, Nicole Bottass, Kristen Bretz, and the entire the entire team in the Office of Undergraduate Research for hosting this event and supporting our undergraduate researchers throughout the year.

Thanks to the Fralin Life Sciences Institute, the Institute for Critical Technology and Applied Science, and to Dr. Dennis Dean for continuous support and advocacy for undergraduate research and to the many colleagues who have contributed to building an endowment for this symposium.

Enjoy the conference!

Jill

Office of Undergraduate Research

Keri Swaby

Director of Undergraduate Research

Welcome to the annual Dennis Dean Undergraduate Research and Creative Scholarship conference, hosted by Virginia Tech's Office of Undergraduate Research (OUR). This is our tenth year offering a campus-wide event that showcases the breadth of research and creative scholarship taking place across campus every day.

Presenting results of a research or creative project is an important part of a student's overall journey because it provides them with the opportunity to learn to effectively communicate to a broad audience, defend their work, exchange ideas, and be inspired for future directions. This year we feature the work of 447 students, including thirteen (13) students from Blacksburg High School, who will present 247 posters throughout the day. I invite you to take your time and explore the many fascinating projects being presented at the conference and I challenge you to stop at posters with titles that might sound ominous to you. You will be impressed by the variety and high quality of the work on display and the students' ability to break down their work so that it is understandable to the broad audience at the conference.

The conference is only possible through the incredible hard work of our Program Assistant, Nicole Bottass, and OUR Assistant Director, Dr. Kristen Bretz; the guidance of our active and insightful advisory board; and the army of amazing student Ambassadors who share their passion every day as they help students navigate undergraduate research. Without these dedicated people, the operations of the OUR would not be possible.

I must recognize and specially thank the Offices of Undergraduate Academic Affairs and Undergraduate Education, as well as the Fralin Life Sciences Institute and the Institute for Critical Technology and Applied Science, whose financial support allows us to celebrate undergraduate research and creative scholarship today and every day.

As always, I am humbled by the quality of work on show at this conference and invite you to marvel at the wealth of research and creative scholarships the university has to offer. I invite you to engage, to explore, to connect, and to have fun!

Keri

ACC Meeting of the Minds

The 2024 ACC Meeting of the Minds (ACC MOM) was held at University of Notre Dame. The scheduled conference dates were April 5-7, 2024. The Office of Undergraduate Research would like to recognize the students who presented.

Each year, 5-10 outstanding undergraduate researchers (accompanied by a faculty/staff member) from each ACC university gather at a host institution to present their research, either orally or as a poster. Virginia Tech representatives are selected by a competitive refereed process. It is truly an honor to be invited to participate in this conference. Student name, academic major, title of presentation, and faculty mentor listed below alphabetically.

Enma Navarro, Landscape Architecture
Comparing Pathway Methods for Agroforestry Design
Dr. John Munsell and Professor Emeritus Ben Johnson

Nicole Odibo, Public Health
Development of a Surface-Enhanced Raman Scattering (SERS) based Nanoprobe for Leaf pH Detection
Dr. Peter Vikesland

Thomas Lu, Computer Engineering and Electrical Engineering
Development of Histotripsy Systems for the Precise, Complete, and Non-Invasive Ablation of Osteosarcoma Tumors using Robotic Targeting Methods
Dr. Eli Vlaisavljevich

Maddie Ferguson, Biochemistry
Iron-sulfur Cluster Assembling Thioredoxin from Methanocaldococcus Jannaschil
Dr. Biswarp Mukhopadhyay

David Beck, Cognitive and Behavioral Neuroscience
Embryonic Heat Exposure Leads to Greater Stress Resiliency Later in Life: Molecular and Morphological Mechanisms in the Gut
Dr. Elizabeth Gilbert

NCUR

The 2024 National Conference on Undergraduate Research (NCUR) was held in Long Beach, California. The scheduled conference dates were April 8-10, 2024. The Office of Undergraduate Research would like to recognize the students who were selected to present.

The National Conference on Undergraduate Research (NCUR), established in 1987, is dedicated to promoting undergraduate research, scholarship, and creative activity in all fields of study by sponsoring an annual conference for students. Unlike meetings of academic professional organizations, this gathering of young scholars welcomes presenters from all institutions of higher learning and from all corners of the academic curriculum. Through this annual conference, NCUR creates a unique environment for the celebration and promotion of undergraduate student achievement, provides models of exemplary research and scholarship, and helps to improve the state of undergraduate education.

Student name and academic major listed below alphabetically.

Anastasia Semenova, Psychology

Brandon Bickley, Entomology

Evan Alvarez, Psychology

Kailynn Roberts, Health Science

Kristen Folk, Animal Science

Madeline Radosevic, Animal Science

Michael Wilson, SPES

Tyler Parker-Rollins, Psychology

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.

Environmental Health and Safety

Molecular and Cellular Biology Graduate Program

Translational Biology, Medicine, and Health

Office of Scholarly Integrity and Research Compliance

Virginia Tech Graduate School

2023-24 Travel Grant Awards

The Virginia Tech Office of Undergraduate Research encourages students to present their research at conferences. OUR travel support program will cover expenses related to presenting at a conference. This rolling review process is designed to assist undergraduate students who have had their research or creative scholarship accepted for presentation at a regional, national, or international conference. This program will provide travel funding to students who, without this support, may not be able to attend a conference to present their work. Current undergraduates from any discipline are eligible to apply for travel support.

Ana Sememova, Psychology, College of Science
Faculty Mentor: Dr. E. Scott Geller
APA 2023, August 3-5, 2023

Kiya Rahn, Wildlife Conservation, College of Natural Resources and Environment
Faculty Mentor: Dr. Jordan Metzgar
Botany 2023. July 22-26, 2023

Amelia Schmidt, Animal and Poultry Sciences, Wildlife Conservation, College of Agriculture and Life Sciences
Faculty Mentor: Dr. Jordan Metzgar
Botany 2023. July 22-26, 2023

Amiya Jenkins, Medicinal Chemistry, College of Science
Faculty Mentor: Dr. Emily Mevers
National Organization for the Professional Advancement of Black Chemists and Chemical Engineers (NOBCChE). September 11-14, 2023

Alex Solomon, Animal and Poultry Sciences, College of Agriculture and Life Sciences
Faculty Mentor: Dr. Mike Boots
ABRCMS. November 15-18, 2023

Ben Shettel, Biological Sciences, College of Science
Faculty Mentor: Dr. Susan Whitehead
Entomology 2023. November 5-8, 2023

Andres Lopez, International Studies, College of Liberal Arts and Human Sciences
Faculty Mentor: Dr. Abby Walker
New Ways of Analyzing Variation (NWAV) 5. October 13-15, 2023

Gwen Roman, Childhood Pre-Education, College of Liberal Arts and Human Sciences
Faculty Mentor: Dr. Jody Russon
National Conferences on Family Relations. November 8-11, 2023

Dev Patel, Biomedical Engineering, College of Engineering
Faculty Mentor: Dr. Jai Rudra
Biomedical Engineering Society National Conference. October 12-14, 2023

Irene Johns, Mechanical Engineering, College of Engineering
Faculty Mentor: Dr. David Gray
ABRCMS, November 15-18, 2023

Ryan Mann, Chemical Engineering, College of Engineering
Faculty Mentor: Dr. Michael Bortner
Gulf Coast Undergraduate Research Symposium. October 20-22, 2023

Vasu Gatne Computer Science, College of Engineering
Faculty Mentor: Dr. Anirudh Prabhu
American Geophysical Union Fall 23 Meeting. December 11-15, 2023

Melanie Lindblom, Chemical Engineering, College of Engineering
Faculty Mentor: Dr. Erdogan Kiran
2023 AICHE Annual Student Conference. November 4-7, 2023

Cleo Orlando, Microbiology, College of Science
Faculty Mentor: Dr. Amanda Morris
Southeast Regional Meeting of the American Chemical Society, October 25, 2023

Emma Troiano, Chemical Engineering, College of Engineering
Faculty Mentor: Dr. Erdogan Kiran
2023 AIChE Poster Competition. November 6, 2023

Elea Abisamra Cognitive and Behavioral Neuroscience, Nanomedicine, College of Science
Society for Neuroscience Conference. November 11-15, 2023

Simba Srivastava, Geosciences, College of Science
Faculty Mentor: Dr. Sterling Nesbitt
200 Years of Dinosaurs: New Perspectives on an Ancient World. January 11-12, 2024

Emma Feinstone, Applied Discrete Mathematics, College of Science
Faculty Mentor: Dr. Rachel Arnold
2024 SIGMAA on RUME Conference. February 22-24, 2024

Kamau Braxton-Hall, Biological Sciences, College of Science
Faculty Mentor: Dr. Ignacio Moore
The Society for Integrative and Comparative Biology. January 2-6, 2024

Vincent Parente, Communication, College of Liberal and Human Sciences
Faculty Mentor: Dr. Jim Kuypers
34th Annual Theodore Clevenger, Jr. Undergraduate Honors Conference – Southern States Communication Association. April 3-7,2024

Lily Casteen, Wildlife Conservation- Human Dimensions Concentration, College of Natural Resources and Environment
Faculty Mentor: Dr. Elizabeth Nyboer
American Fisheries Society- Southeast Division. January 31 – February 4,2024

Iymonie Martin, Psychology and Political Science, College of Science and College Liberal Arts and Human Science
Faculty Mentor: Dr. Jim Kuypers
Southern States Communication Association Conference (SSCA). April 4-7,2024

Morgan Mosco, Mechanical Engineering, College of Engineering
Faculty Mentor: Dr. David Dillard
The Adhesive Society 47th Annual Meeting. February 11-14,2024

Rebecca Rainhart, Micro/Nanosystems, College of Engineering
Faculty Mentor: Dr. Kenneth Schulz
8th IEEE Electron Devices Technology and Manufacturing Conference. March 3-6,2024

Walter Dickey, Clinical Neuroscience, College of Science
Faculty Mentor: Dr. Christopher Arena
2024 Design of Medical Devices Conference. April 8-10,2024

Jennifer Rechani, Biomedical Engineering, BEAM
Faculty Mentor: Dr. Christopher Arena
2024 Design of Medical Devices Conference. April 8-10,2024

Sarah Scheerer, Biomedical Engineering, College of Engineering
Faculty Mentor: Dr. Christopher Arena
2024 Design of Medical Devices Conference. April 8-10,2024

Bianca Campos, Biomedical Engineering, College of Engineering
Faculty Mentor: Dr. Christopher Arena
2024 Design of Medical Devices Conference. April 8-10,2024

Mollie Schoeppner, Biomedical Engineering, College of Engineering
Faculty Mentor: Dr. Christopher Arena
2024 Design of Medical Devices Conference. April 8-10,2024

Rebecca Rainey, Industrial Design, College of Architecture, Arts, and Design
Faculty Mentor: Dr. Christopher Arena
2024 Design of Medical Devices Conference. April 8-10,2024

Alexander Gioia, Mechanical Engineering
Faculty Mentor: Dr. Robin Queen
The American College of Sports Medicine. May 28-31,2024

Riley Petersen, Public Relations
Faculty Mentor: Dr. Zack Sowder
NACC 23rd Annual Excellence at the Center Conference. April 12-13,2024

Hiya Barai, Biological Sciences
Faculty Mentor: Dr. Sally Entrekin
Society for Freshwater Science Annual Meeting. June 2-6,2024

Nikola Iakimov, Computer Science
Faculty Mentor: Dr. Elena Serrano
MIRPO 2024. May 20-24,2024

Catherine Caputo, Construction Engineering and Management
Faculty Mentor: Dr. Ashtarout Ammar
The International Association for Automation and Robotics in Construction. June 3-7,2024

Rebecca Rainey, Industrial Design, College of Architecture, Arts, and Design
Faculty Mentor: Dr. Christopher Arena
2024 Design of Medical Devices Conference. April 8-10,2024

Office of Undergraduate Research Ambassadors

Amiya Jenkins (Graduation: Spring 2024)
Medicinal Chemistry & Biochemistry – Medicinal Chemistry, Natural Products, Drug Discovery

Andrea Escalante (Graduation: Spring 2024)
Mechanical Engineering & Mathematics – Coding and Cryptography (Graph Based Decoding)

Brianna Reilly (Graduation: Spring 2026)
Neuroscience – Concussion Science, Biomechanics & Sports Safety Engineering

Claudia Budzyn (Graduation: Spring 2024)
Environmental Politics – Environmental educational and international policy

Eva Snaith (Graduation: Spring 2024)
Biochemistry & Biological Sciences – Mosquito-borne pathogen prevalence in Virginia & biochemical constraints and trade-offs between sugar and blood feeding in mosquitos

Gabrielle Carter (Graduation: Spring 2025)
Biology & Chemistry – Plant pathogen interactions and plant biochemistry

Irene Johns (Graduation: Spring 2024)
Mechanical Engineering – UAV Camera payload systems, VTGT Race Car Development

Katherine Ngo (Graduation: Spring 2024)
Biological Sciences – Mammalian circadian biology

Laura Zhang (Graduation: Spring 2024)
Human Development and Family Science – Child and adolescent development, adult development and aging, biology – neuroscience and material nutrition

Makenzie Woolls (Graduation: Spring 2023)
Public Health – Immunology, Virology and Plant Genetics

Maddie Ferguson (Graduation: Spring 2024)
Biochemistry – Anaerobic methanogen growth and analysis, nitrite, and sulfite reductase

Morgan Harvey (Graduation: Spring 2024)
Environmental Science – Sustainable materials and agricultural greenhouse gases

Nikki Keith (Graduation: Spring 2024)
Biological Sciences & Clinical Neuroscience – Histotripsy, Focused Ultrasound, Neuro-oncological Therapeutics, Medical Device Development

Olivia Cox (Graduation: Spring 2025)
Psychology And Human Development – Child and Clinical Psychology

Reagan Schere (Graduation: Spring 2025)
Physics – Astrophysics, Radio Astronomy & Data Analytics -

Sasha Mintz (Graduation: Spring 2024)
Physics – Astrophysics, Cosmology, Particle Physics

Thiviya Karuppasamy (Graduation: Spring 2026)
Microbiology and Public Health – Plant pathology & environmental, aerosol and plant microorganisms

2023-24 Outstanding Undergraduate Research Mentor Award

An often overlooked, unrecognized and unrewarded mode of teaching is mentoring undergraduate students in research. Four years ago, the Office of Undergraduate Research launched the Outstanding Undergraduate Research Mentor Award - for a Faculty and a Graduate Student - to recognize the hard work, time, dedication, and guidance that research mentors provide to undergraduate students.

Undergraduates were asked to nominate one Virginia Tech faculty or graduate student research mentor from any discipline for this award. We received nominations for faculty members and for graduate students. It was extremely humbling and inspiring to review the thoughtful and passion-filled nominations. Many recognized the tireless and often unrewarded efforts of their mentors and indicated that their mentor made their Virginia Tech experience unique and overwhelmingly had a positive impact on their future plans.

Meredith Steele

The recipient of this year's **Outstanding Undergraduate Research FACULTY Mentor Award is Meredith Steele, PhD, Associate Professor in the School Plant and Environmental Sciences**. In their two nominations, the students described Dr. Steele as patient and exposed students to experience all aspects of research.

The recipient of this year's **Outstanding Undergraduate Research GRADUATE STUDENT Mentor Award is Gillian Su (Chemistry)**, who received two nominations. In her nominations, Gillian was described as friendly, welcoming, and her hard work is contagious.

Thank you to all undergraduate research mentors. Without mentors, students could not engage in research and without exceptional mentors, students would not gain as much out of the research experience!

Thank you to the Office of Undergraduate Research Advisory Board!

For sharing your knowledge, experience, advice, and hard labor with us and your fellow students, faculty, and staff at Virginia Tech. The Office of Undergraduate Research would not have near the impact or be able to provide near the opportunity without your incalculable dedication and support.

Advisory Board

Brian Badgley
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Yancey Crawford – co-chair
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Hannah Glisson
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Monica Hunter
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Amanda MacDonald
Frank May
Konark Mukherjee
Isabel Prochner
Rachel Reid
Wester Santos
Kory Trott
Eli Vlaisavljevich
Abby Walker

Student Members:

Maddie Ferguson
Olivia Cox
Amiya Jenkins

Conference Schedule & Abstracts

Conference Schedule

Session 1: 8:00-8:50 a.m.

Primary Presenter Last Name	Presentation Title	Poster Number
Chamberlain	Impact of Leaf Litter on the Water-Staining Process	1
Crowe	Study of Conservation in Virginia using Bobwhite Quail as an Indicator Species.	2
Cullen	Climate Action Living Laboratory Framework at Virginia Tech: Community-Engaged Service Learning in Practice	3
Folk	Impact of heat stress on mammary insulin receptor distribution in lactating dairy cows	4
Gitre	The Impact of Environmental Methylmercury Exposure on the Feeding Rates of Invertivorous Passerines	5
Ilijoski	ASSOCIATION BETWEEN GENDER AND COGNITIVE FLEXIBILITY TRENDS IN 9-YEAR-OLDS.	6
Jakoubek	Investigating the Factors Which Allow for the Stability of Planetary Orbits in Binary Star Systems Using Numerical Simulations Based on Initial Planetary Positions	7
Lahmers	Relationship Between Below Ground Biomass and Soil Organic Matter: a Case Study in Mt Tabor, Blacksburg	8
Lee	The Causes of Spontaneous Firing of Cardiac Muscle and Effects of Ion Concentration	9
Li	Enhancing Driving Safety via Real-Time Suppression of Vehicle Radar Interference	10
Liu	The Impact Comparison of Artificial Intelligence on Different Occupations in the Labor Market	11
Lopez	Investigating merger of marginally contrastive conditioned vowels: Perception and production of pre-lateral FOOT and STRUT class words.	12
Lu, R	Systematic Assessment of Large Language Model's Correctness and Biases for Minority Health	13
McIrvin	Low Level Control Methods for 3D-printed Quadruped Robot	14

Session 2: 9:05-9:55 a.m.

Primary Presenter Last Name	Presentation Title	Poster Number
Anjum	The Microsystem and Language Development: A Longitudinal Assessment	1
Beamer	Using arboreal camera traps to assess the role of Appalachian animals in the seed dispersal of a high elevation berry	2
Blackwell	Are Commercial Microplastics An Adequate Comparison To Environmentally Realistic Microplastics?	3
Brandt	What is the Effect of Encased Bamboo on the Mechanical Properties of Cross Laminated Timber (CLT)?	4
Campbell	Investigating Binding Efficiencies of Various Opioids to the μ-Opioid Receptor	5
Cann	Vector competence of Aedes albopictus for vertical transmission of La Crosse virus	6
Castro	EARLY CHILDHOOD PREDICTORS OF ADHD: EXPLORING THE ROLE OF INFANT DISTRESS, CHILDHOOD IMPULSIVITY, AND MATERNAL NEGATIVITY	7
Chava	Investigating Differences in How Verbal Behavior Relates to Self-Reported and Observer-Rated Personality Traits	8
Cox	Educating Adolescents about Neuroscience and the Effects of Substances on the Brain	9
Dana	Assessing Macroinvertebrate and Primary Producer Populations and Their Habitats Across Biomes	10
Donald	Analyzing the Impact of Mutations in the JAR1 Active Site of Arabidopsis thaliana.	11
Feinstone	Obstacles of Learning Proof by Cases	12
Ferguson	Iron-Sulfur Cluster Assembling Thioredoxin of Methanocaldococcus jannaschii	13
Flanagan	Variation in Hydrologic Signatures in the Southern Appalachian Mountains and Continental United States	14
James	Copula Absence Variation in New Orleans English	15

Katsapis	Lifestyle factors and physical biomarkers that predict cognitive outcomes in later life	16
Lopez	Formalizing Coronal Nasal-Obstruent Cluster Reduction in American English	17
Maso	Evolutionary Ethics - Analyzing morality through the lens of natural selection	18
Mathov	Evidence of Arboviral Circulation in Swanson, New York via Serosurveillance in Wildlife	19
Morris, L	Assessing predictability of community reintegration for inmates upon release	20
Ngo, K	Determining the Optimal Approach for Comparing Rhythmic Datasets	21
Perez	Shape Analysis of Radar Reflectivity Plots to Detect Hazards Associated with Supercell Thunderstorms	22
Radosevic	The Evaluation of Equine Diets for Determination of Nutrient Deficiencies and Surpluses	23
Reitmeier	Use of an Asset Frame in Nutrition Education Reporting to Reduce Stigma	24
Rowe	Observing changes in macroinvertebrate density and evenness across biomes	25
Stockman	Save a Horse, Know Your Pasture: A Guide to Identifying Plants Toxic to Livestock For Virginia	26
van Marcke de Lummen	Modeling & Analysis of Electricity and Greenhouse Gas Emissions in the Built Environment: Case Study	27
Wiscarson	Comparing predicted binding affinities of ceftriaxone and cefotaxime in β-lactamase.	28
Youngs	Focused Ultrasound Modifies Tumor Microenvironment and Improves Systemic Anti-Tumor Immunity During Ablation of Pancreatic Tumors	29
Erb	UNCOVERING THE MECHANISMS OF COLOR IN MINERAL-BASED COMMERCIAL PEARLESCENT AND METALLESCENT PIGMENTS	30
Abisamra	Lipidomic Analysis of the Giant Virus PBCV-1	31

Session 3: 10:10-11:00 a.m.

Primary Presenter Last Name	Presentation Title	Poster Number
Abdullah	The Role of Tyrosine 326 in Mu-Opioid Receptor Function	1

Nazigian	A American English Variant: Indefinite determiner variation in American Englishes	20
Parker-Rollins	Psychological Safety in University Classes: Evaluating Personal Engagement in the Classroom	21
Parrish	Mineralogical Analysis and Classification of the Kiowa Meteorite Sample Utilizing Electron Microprobe Techniques	22
Patil	Automated segmentation of the thoracolumbar fascia using AI	23
Pletch	Understanding how fruit-frugivore interactions affect range shifts in plants across Appalachia	24
Rhodes	Using Virtual Screening Methods to Develop Antivirals for Proteases, Transferases, and Polymerases in Dengue and Chikungunya Viruses	25
Smith, Annabelle	The Role of Parent Emotion Coaching and Emotion Dismissing in Child Emotion Regulation	26
Sobot	Team Malawi Team-Science: Drone/GIS	27
Styles	A Community Approach to Combating the Opioid Epidemic: Integrating Education and Action	28
Thornton	Schistosomiasis Mapping for prevention, education, and economic growth	29
Zaslavsky	TEAM-Malawi Hydroponics Implementation Plan	30
Mann	Processing of Melt-Blended Ternary Polymer-Clay Composites for Additive Manufacturing	31

Session 4: 11:15 a.m.-12:05 p.m.

Primary Presenter Last Name	Presentation Title	Poster Number
Acosta	Deletion of mitochondrial calcium uniporter reduces spine head size in CA2 dendrites	1
Alvarez	Naturalistic Observations of Interpersonal Gratitude: Relative impact of modeling vs. diffusion of responsibility	2
Beck	Embryonic Heat Exposure Leads to Stressor Resiliency Later in Life: Molecular and Morphological Mechanisms in the Small Intestine	3
Berckmueller	Transgenerational Effects of Ethanol Exposure in Caenorhabditis elegans	4
Bickley	Validation of the Insect Type-B Muscarinic Acetylcholine Receptor (mAChR-B) as a Novel Insecticide Target	5

Riggan	Exploring seasonality in jaguar mating behavior via remote camera traps, in Belize	24
Samanta	Investigating the Effect of Peripheral CSF Overexpression on Microglial Function in Ovarian Tissue	25
Savelyev	Walking with a Cellphone: Naturalistic Observations of Social and Emotional Impact	26
Smith, S	The Art of Appreciation: Exploring Gratitude Expression in Romantic Relationships	27
Tea	Evaluation of single-use cutlery degradation in a home composting environment	28
Thibodeau	Do tire road wear particles (TRWPs) influence the accumulation of metals by Daphnia magna?	29
Zaleski	Exploring the impact of choral group singing on the feelings of choir members and quality of life of persons with dementia and their respective caregivers.	30
Hines	Understanding Tetrodotoxin Resistance and Nav2 Channels in Echinodermata	31

Session 5: 12:20-1:10 p.m.

Primary Presenter Last Name	Presentation Title	Poster Number
Athumani	Role of TGIF1 in idiopathic pulmonary fibrosis	1
Bejtlich	Evaluating the Accuracy of Source-Finding Algorithm (SoFiA) in Detecting HI Hotspots	2
Bodale	Generation of Hyperactive Mutants of the TOR Protein to Study Amino Acid Metabolism in Plants	3
Collins	Factors influencing occupancy and detection of margays (Leopardus wiedii) in tropical broadleaf forest versus a unique tropical pine forest in Belize, Central America.	4
Brown	Observing the Dopaminergic Function of C. Elegans Treated With Cannabidiol Oil	5
Burgos	Role of Medication Status in the Social and Academic Profiles of College Students with ADHD	6
Carrion	Evaluating Examples of Indigenous Turtle Use and its Legality	7
Casteen	Angler attitudes toward longnose gar in Virginia's recreational fisheries: Ecological outcomes and management implications	8
Childress	Maternal Parenting, Child Effortful Control, and Academic Skills Across Early Childhood	9

Ridgway-Davis	Expanding The Just Say Know (JSK) Substance Use Education Program to Southwest Virginia Elementary and High School Students	29
Smith, S	Translating Electroencephalogram Signals into Mechanical Output with OpenBCI Technology	30
Olejnicki	Mesh-Harp Hybrids for Anti-Tangling and Anti-Clogging Fog Harvesting	31

Session 6: 1:25-2:15 p.m.

Primary Presenter Last Name	Presentation Title	Poster Number
Cain	Stockpiled Fescue Yield and Quality Responses to Nitrogen Fertilizer	1
Cleveland	Characterizing Oligomeric Amyloid-β42 and POPC Interactions Through Molecular Dynamics: A Computational Approach for Understanding Alzheimer's Disease	2
Daniel	Practical Interventions to Decrease the Use of Plastic Bags; Behavioral observations at two large grocery stores	3
Do	Role of Perm1 in Systemic Muscle Dysfunction of Heart Failure	4
Elbash	Integrating lecture learning and Community-Engaged Learning (CEL) in Neuroscience of drug addiction.	5
Fuccello	Comparing Beta D-Fructopyranose and Glucose Binding to Glucokinase	6
Gatne	Predicting Exoplanet Occurrence Using Association Analysis	7
Glaser	Understanding How Pubertal Development Influences Neural Cognitive Control and Neural Reward Processing in Adolescents	8
Haddadin	Antibiotic Resistance Profiles of Escherichia coli isolated from Elephants in the Chobe Region of Botswana	9
Hafeez	Never Enough Book Club - A Community Engagement Project	10
Hampton	“I would like a diet Sprite” /ay/ monophthongization in Southwest Virginia	11
Hassouna	Culturing microbes from old cultivars of crops; Diversity hidden by time	12
Kalathur	Exploring the Role of Maternal-Child Interactions in the Development of Child Attention Problems	13

Session 7: 2:30-3:20 p.m.

Primary Presenter Last Name	Presentation Title	Poster Number
Augustine	Acetylcholinesterase Mutagenesis: The effect of mutating Trp-127 on Huperzine A's Binding Affinity for the active site of Acetylcholinesterase	1
Burgiss	Effect of Desiccation on Lichen Photosynthesis	2
Carter, G	Arabidopsis thaliana AAP6 involvement in response to Phytophthora capcisi infection	3
Chen	Waste Not: The potential for value-retention through diversion and recovery.	4
Deapera	Heart-Rate Variability Correlates of Collaboration Among Neurodiverse Dyads	5
Dickey	MATERIAL COMPARISON FOR SURGICAL SIMULATION MODELS	6
Ealy	Chitosan as a Sustainable Approach to Improve Soybean Iron Deficiency Chlorosis	7
Fox	Investigating Additive Manufacturing Challenges in Low-Resource Settings through the Biodesign Needs-Finding Process	8
Gregory	Characterizing X1 in SARS-CoV-2 infection	9
Hou	Super low-dose endotoxin reprograms neutrophils for targeted cancer treatment in vitro	10
Jethwani	Improving the methodology for estimating ruminal fiber digestibility.	11
Krzysik	The Next Generation of War	12
Magee	Tracking Antimicrobial Resistance in SWVA through Septage Surveillance	13
Maguire, M	The Variability in Energy Expenditure Among Female Soccer Players	14
Miller, C	Characterizing the Electronic Impact of Phosphorylation on GSXS Tetrapeptides	15
Morris, K	The Impact of Voice Assistant Accent on User Experience	16
Morse	Documenting Bird Mortality from Window Collisions on the Virginia Tech Campus	17
Nance	Psychological Safety Within the Transgender Community at Virginia Tech	18
O'Brien	Investigating S1PR3 Upregulation by Interstitial Fluid Flow in Glial Cells	19

Odibo	A Comparative Analysis of Agrivoltaics and Solar Energy in Virginia and Massachusetts	20
Orr	PD-L1 and TGFβ reduce effects of irreversible electroporation on pancreatic cancer	21
Pho	Adrenergic Receptor Antagonists Reduce Herpes Simplex Virus 1 Recurrences but Not From Sensory Neurons	22
Purvis	A comparative assessment of Tire Wear Particle Toxicity by brand	23
Rana	Neuroscience Demos for Elementary and High School Students	24
Rashkovsky	Protoplast but Not Least: Upping the Ante in Transformation Efficiency	25
Semenova	A Student-to-Teacher "Thank You": Effects of Expressing Gratitude on Subjective Well-Being	26
Strobel	Socioeconomic Status as a Moderator of Relations between Family Conflict and General Psychopathology in the Adolescent Brain Cognitive Development Study	27
Taylor, Nadyezhda	Well-being and Academic Performance: How Should College Academics Consider Seligman's PERMA Model	28
Taylor, C	Inclusion Complex Technologies to Improve Bioplastic Thermal Stability	29
Walker	Differences in Water Quality in Differing Areas of Local Land Usage	30
Wang, J	VT Minecraft Museum	31

Session 8: 3:35-4:25 p.m.

Primary Presenter Last Name	Presentation Title	Poster Number
Beasley	The Effect of Environmental Factors on Faxonius cristavarius in Stroubles Creek	1
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Abstracts

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The Role of Tyrosine 326 in Mu-Opioid Receptor Function

Opioids are drugs that are prescribed for severe pain relief. Researchers and medical professionals are continuously looking for ways to design opioids to work at peak efficiency and produce maximum pain relief. In the cellular membrane of neurons, the mu-opioid receptor protein binds to ligands, activating signals in the neuron to reduce pain. In respect to the mu-opioid protein's function, the binding pocket of this receptor is crucial. In this paper, we observed the effects of changing the Tyrosine 326 (TYR326) amino acid to alanine, a hydrophobic amino acid, to understand the role TYR326 plays in the protein function. Using molecular docking, we explored the effects of both amino acids on binding affinity and observed how the receptor protein changed in ability to bind opioids. Initially, we observed a binding affinity of -8.3 kcal/mol with TYR326. Subsequently, when TYR326 was replaced with alanine, the results indicated a binding affinity of -7.9 kcal/mol. Therefore, our results showed that alanine produced a lower binding affinity than TYR326. This suggests that TYR326 plays a major role in how effective the protein is in opioid reception as more negative binding affinity indicates favorability of protein-ligand interactions. Future research can use these findings to design drugs that are highly compatible with TYR326 as it heavily influences the function. Furthermore, this research can examine if opioids designed to work compatibility with TYR326 may be able to enhance the quality of the drug with less side effects.

Mentor(s): Anne Brown, University Libraries, Virginia Tech

Elea-Maria Abisamra

Virginia Tech/Cognitive and Behavioral Neuroscience

Lipidomic Analysis of the Giant Virus PBCV-1

Our project revolves around a lipidomic analysis of a giant virus named Paramecium Bursaria Chlorella Virus 1 (PBCV-1), a virus of an algae that lives inside of Paramecium bursaria. Lipidomics is a recently emerged field focused on cellular lipids and primarily utilizes mass spectrometry, which measures mass-to-charge ratios (m/z).//Using the Lab Solutions software and a variety of resources, we were able to identify the four primary lipid classes within the first week: diacylglycerols, phosphatidylcholines, glycosyl-based lipids, and cardiolipins. Since then, we have worked to find each class' specific lipid constitutes in the sample. //By combining different softwares, such as Labsolutions CS, the MoNA MassBank of North America, and LipidMaps.org, we were able to identify the most abundant lipids in the sample based on the length of their fatty acid chains and chemical modifications of their structures. Once a lipid was identified, a Lipid Maps ID was evaluated from the database, which provided established MoNA Spectra data. The MoNA Spectra had to match the Labsolutions data from our sample for the targeted lipid to prove a match. //We have purchased the most relevant lipids to generate artificial lipid bilayers known as liposomes, and have used liposomes to reconstitute the binding of the purified major capsid protein of PBCV-1 to lipid bilayers. This protein, known as VP-54, is located at the lipid bilayer surface of the virus and it is essential for infectivity. With further analysis, we hope to be able to identify the lipid ligand for VP-54.

Mentor(s): Daniel Capelluto, Biological Sciences, Virginia Tech

Nicole Acosta

Virginia Tech/Clinical Neuroscience

Deletion of mitochondrial calcium uniporter reduces spine head size in CA2 dendrites

Hippocampal area CA2 is vital for social memory, enabling recognition of familiar members of the same species. Memory formation is thought to be driven by long-term potentiation (LTP), where synapses strengthen via structural changes in dendritic spines, the specialized contact sites between neurons. Dendritic mitochondria play a role in providing energy for LTP at dendritic spines. CA2 is enriched in mitochondria-related genes, notably the mitochondrial calcium uniporter (MCU), especially at distal dendrites where LTP occurs. MCU regulates calcium influx into mitochondria and impacts ATP production. Deleting MCU in CA2 (cKO) led to a deficit in LTP at distal dendritic synapses, critical for social memory, however it remains unknown how MCU regulates synaptic plasticity. Using Biodock, a deep learning AI platform, we uncovered mitochondrial fragmentation in CA2 dendrites of cKO mice. Additionally, Golgi staining showed a trending decrease in spine density in distal CA2 dendrites in cKO mice, potentially contributing to LTP deficiency. To further examine dendritic spine ultrastructure, we trained an AI to segment dendrites and dendritic spine heads in electron micrographs from both control (CTL) and MCU cKO mice. We define spines as unattached structures with clear synapses containing a postsynaptic density, a protein dense specialization of postsynaptic membrane. LTP induction increases spine head area, correlating with increased synaptic strength. Hence, we hypothesized MCU deletion would diminish spine head size, consistent with decreased synaptic strength. We observed a preliminary decrease in median spine head area (CTL: 0.14 ± 0.07; cKO: 0.13 ± 0.06), perimeter (CTL: 1.73 ± 0.44, cKO: 1.65 ± 0.40), and total spine head area per image (CTL: 1.91 ± 0.79; cKO: 1.76 ± 0.79). However, we found no difference in median aspect ratio and count per 100 um2. A reduction in spine head area may explain synaptic plasticity deficits and suggests a role for MCU in spine morphology. Our findings may help understand mechanisms behind social deficits in neurodevelopmental disorders.

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Barriers to Education in the Kakuma Refugee Camp

Students in the Kakuma Refugee Camp in Kenya face significant challenges in their education. Previous researchers have identified numerous barriers, including large class sizes, lack of resources in schools, hunger within the camp, language barriers within schools, and a lack of training amongst teachers. Based on interviews with former refugee students and teachers within Kakuma, this study sought to further examine barriers to education within Kakuma with regard to issues in physical infrastructure and challenges that teachers face, including issues overlooked in previous research. Through analyzing data from our interviews, we confirm previous findings on numerous challenges teachers face, including lack of training, large class sizes, and under-resourced schools. Furthermore, we argue that these issues cause numerous challenges that have not been previously discussed extensively in research. These challenges include the use of corporal punishment, lack of confidence amongst teachers, and less respect for refugee teachers as opposed to Kenyan teachers. In addition, our analysis of interview data documents multiple challenges regarding the physical infrastructure of schools and how this affects student learning. This study concludes by discussing the multitude of challenges that Kakuma students face in obtaining a formal education and how this diminishes their prospects for better lives.

Mentor(s): Brett Shadle, History, Virginia Tech

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Naturalistic Observations of Interpersonal Gratitude: Relative impact of modeling vs. diffusion of responsibility

This naturalistic observational study compares the differential influence of two notable psychological theories -- observational learning and diffusion of responsibility. Observational learning predicts people will take cues from the actions of others and model relevant behavior. On the other hand, diffusion of responsibility predicts that people will be less likely to take responsibility for the welfare or wellbeing of another person if others are available to actively care. This field study observed expressions of interpersonal gratitude on campus buses, as a function of other passengers expressing similar gratitude. Specifically, undergraduate researchers have been recording whether passengers thank bus drivers as they disembark, and whether a "Thank you" is influenced by the drivers exhibiting prosocial behavior (e.g., saying "Have a nice day!"). Analysis is ongoing and focused on whether passengers exhibit observational learning or diffusion of responsibility more often. Our observations have indicated that prosocial behavior exhibited by the driver increased expressions of gratitude from exiting passengers. Out of the 7,508 passengers observed, 57% followed a driver's kind remarks with a "Thank You". However, those passengers exiting after this passenger were less likely to express gratitude, supporting diffusion of responsibility over modeling or observational learning. Observations are ongoing and additional findings will be reported.

Mentor(s): Scott Geller, Psychology, Virginia Tech
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The Microsystem and Language Development: A Longitudinal Assessment

Socioeconomic factors play a role in early language development (Lecheile et al., 2020; Ma et al., 2021). Some have also shown individual vocabulary and social factors within a child's microsystem to predict language development (Ebert et al., 2020), but this is not widely studied. The goal of our study was to add to the research on the child's microsystem and language development by assessing child vocabulary (VOCAB) and birth order (BO) and maternal education (mEDU).

Children (n = 171) were assessed at 10-, 24-, 36-, and 48-months. Maternal report was used for mEDU at 10-months, VOCAB at 24-months, and BO at 36-months. At 48-months, child language was measured using a picture-word vocabulary test. With child language as our outcome, we used a hierarchical regression model for our analyses. Step one included mEDU, step 2 included VOCAB and BO, and step 3 included interactions among the predictors.

Steps 1 and 2 were significant (ps < .001). mEDU explained 20% of variance in language. Higher levels of mEDU predicted better language (B = 0.45, p < .001). VOCAB and BO explained another 17% of variance in language. Higher VOCAB predicted better language (B = .39, p < .001). BO was associated with language (B = -.15, p = .02), meaning that firstborns had better language than laterborns. None of the interactions were significant. Our results suggest that our microsystem-focused variables strongly and independently predict language, adding to the limited research on this topic.

Mentor(s): Martha Ann Bell,Psychology, Virginia Tech
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Virginia Tech/Microbiology - Biomedical

Role of TGIF1 in idiopathic pulmonary fibrosis

Idiopathic pulmonary fibrosis (IPF) is a progressive lung disease with a median survival period of 2 to 3 years from the onset of respiratory symptoms. IPF is characterized by the presence of both hyperproliferative fibroblasts/myofibroblasts and excessive deposition of extracellular matrix. While the current antifibrotic therapies slow the decline of lung function in patients with IPF, it is not clear if these drugs can improve quality of life and survival. Therefore, novel therapeutic approaches directly targeting the lung remodeling process are desperately needed. Numerous studies have shown that transforming growth factor-β1 (TGF-β1) plays a central role in the development of IPF. TG-interacting factor 1 (TGIF1) is a transcriptional repressor and an inhibitor of the TGF-β pathway. However, the regulation and the effects of TGIF1 in IPF remain to be investigated. I found that TGIF1 expression is significantly decreased in lung fibroblasts from human patients with IPF. In addition, I found in the bleomycin (BLM) mouse model of IPF a decrease in pulmonary TGIF1mRNA level. In vitro, we observed that TGIF1 inhibition increases lung fibroblast proliferation and migration. Taken together, our data reveal decreased level of TGIF1 in IPF, and indicate that TGIF1 inhibits lung fibroblast dysfunction in vitro. Thus, TGIF1 overexpression may be a potential therapeutic target for IPF.

Mentor(s): Yassine Sassi, FBRI, Virginia Tech
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Acetylcholinesterase Mutagenesis: The effect of mutating Trp-127 on Huperzine A's Binding Affinity for the active site of Acetylcholinesterase

Researching acetylcholinesterase (AChE) is important because it gives a better understanding of its job in regulating acetylcholine (ACh), a major neurotransmitter in the brain. ACh's job is to degrade AChE to reduce the chances of there being an excessive build-up. If an extensive amount of AChE is left unbothered it can cause severe side effects such as loss of brain and muscle function. This understanding aids in developing treatments for symptoms associated with Alzheimer's, where these processes are disrupted. A lower affinity mutation in acetylcholinesterase facilitates selective inhibition, enabling a controlled increase in acetylcholine to improve cognitive function in Alzheimer's disease. To study the binding pocket of known AChE inhibitor huperzine-A, Trp-127 was mutated to asparagine. Mutating Trp to a smaller amino acid, Asn, was hypothesized to lower the binding affinity of huperzine-A within AChE. Docking was performed to test the insertion of huperzine A within the modified AChE. It was found that the affinity of the mutated receptor had a 4% decrease in binding affinity effectiveness compared to the wild-type receptor. Future research in this area could include replacing Trp 127 with a similar amino acid, such as histidine. Additionally, exploring mutations within the catalytic site of the protein, emphasizing the region where most of the interactions occur, may provide valuable insights.

Mentor(s): Anne Brown, Biochemistry, Virginia Tech

Baxter Beamer
Virginia Tech/Wildlife Conservation

Using arboreal camera traps to assess the role of Appalachian animals in the seed dispersal of a high elevation berry

Bird-mediated seed dispersal is a key ecosystem function that maintains plant species diversity and distributions, yet our knowledge of species interactions is largely restricted to tropical forests. Many birds track fruit resources over long distances, but climate change is likely to restructure avian seed dispersal networks as it has been demonstrated to alter patterns of bird migration and plant phenology. There have been no full-season studies on bird-plant seed dispersal interactions in the temperate forests of Central Appalachia and the methodological efficacy of observing these interactions is also untested in this region. We utilized arboreal camera trapping to assess the role of migratory birds in the seed dispersal of a widespread fruiting shrub mountain winterberry (Ilex montana) at a high-elevation site in western Virginia. This will allow us to evaluate frugivore assemblage and fruit removal rates by birds on winterberry. As the fruiting window of winterberry aligns with the southbound migration of songbirds, we will compare bird visitation rates on fruiting winterberries to nightly migration volume across fall 2023 recorded by Cornell Lab of Ornithology's BirdCast migration forecasting. We predict neotropical migrants would be important seed dispersers for fruiting plants in fall, and camera trapping is a useful sampling method for observing behavioral interactions between plants and avian seed dispersers in temperate forests. Understanding bird-mediated seed dispersal in Appalachia will have conservation implications as climate change threatens ecosystem function and will inform best future management practices that incorporate species interactions rather than a species-centric approach for conservation prioritization.

Mentor(s): Haldre Rogers, Fish and Wildlife Conservation, Virginia Tech

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The Effect of Environmental Factors on Faxonius cristavarius in Stroubles Creek

Faxonius cristavarius, the spiny stream crayfish, is an invasive crayfish in Stroubles Creek, a heavily urbanized stream in Blacksburg, VA. A previous field study assessing the potential for hybridization between F. cristavarius and Faxonius virilis, found that the standard measures of crayfish morphology changed with very little downstream distance, which has not been previously described in the literature. The current study compared the morphological characteristics of F. cristavarius with environmental variables that change with downstream distance. Understanding how these crayfish adapt in response to habitat variation across a gradient can illustrate how the environment may be altered to prevent invasion. Crayfish were sampled from eight sites along Stroubles Creek during March and April of 2024. Their carapaces, chelae, reproductive appendages, and weight were measured and recorded. The measurements were analyzed using linear models. Preliminary results indicate that the chelae length of F. cristavarius differs spatially, while other characteristics do not. Since chelae are important for mate selection, there may be differing reproductive dynamics in different parts of Stroubles Creek.

Mentor(s): Bryan Brown, Biological Sciences, Virginia Tech

David Beck

Virginia Tech/Cognitive and Behavioral Neuroscience

Embryonic Heat Exposure Leads to Stressor Resiliency Later in Life: Molecular and Morphological Mechanisms in the Small Intestine

Early-life stress increases the likelihood of subsequent health disorders. One potential mechanism may involve epigenetic programming that impacts small intestine function. Developing chick embryos that are incubated at a higher temperature are more stressor-resilient later in life, but the underlying process is poorly understood. In this study, we measured behavioral, morphological, and molecular effects of increased embryonic incubation temperatures and post-hatch heat challenge, in order to understand how embryonic heat conditioning (EHC) affects intestine function. At 4 days post-hatch, duodenum, jejunum, and ileum samples were collected at 0, 2, and 12 hours relative to the start of the heat challenge. We found that markers of oxidative stress and heat stress were decreased while those of nutrient transport were increased in EHC chicks. Crypt depth, a structural marker of stem-cell proliferation, was greater in control than EHC chicks at 2 hours post-challenge, and the villus-height-to-crypt-depth ratio (a marker of absorptive surface area) increased from 2 to 12 hours in both control and EHC chicks. Collectively, these results suggest that EHC chicks might be more energetically efficient at coping with thermal challenge, allowing higher allocation of nutrients to other tissues while protecting the inner lining of the intestine from oxidative damage. With rising global temperatures, heat conditioning has the potential to enhance long-term survivability and promote cross-generational stress adaptation through resiliency in metabolism, immune function, and stress response.

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Elizabeth Gilbert, School of Animal Sciences, Virginia Tech

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Virginia Tech/Physics

Evaluating the Accuracy of Source-Finding Algorithm (SoFiA) in Detecting HI Hotspots

The HI Galaxy Zoo project is a multi-year research collaboration to extract meaningful conclusions from a set of radiometric data from the Westerbork Synthesis Radio Telescope in the Netherlands. Neutral hydrogen (HI) is the universe's most abundant element, and while it exists all throughout empty space, it aggregates when drawn in by galactic gravitational fields. The radiometric data, presented in sets ("cubes") of several hundred frames, uses color to visually highlight spikes in HI emission, which usually indicate the presence of a galaxy at those coordinates. However, analyzing this data is time-consuming and repetitive, so researchers have worked to automate the process. One such automation is Source-Finding Algorithm (SoFiA), created by a team led by Paolo Serra of the Commonwealth Scientific and Industrial Research Organisation in Australia. Our project combines manual and automatic techniques, aiming to determine whether SoFiA is a viable and efficient alternative to manually sorting through HI cubes, capable of finding the same detections as human researchers. Although we anticipate that SoFiA will be highly accurate, and perhaps even better in some instances than we are, we suspect that some subtle detections (especially those consisting of multiple galaxies in close proximity and with similar velocities) will fly under the radar. We will comment on those oversights and suggest whether improvements could be made to how SoFiA evaluates potential detections, such as cross-checking with the NASA/IPAC Extragalactic Database (NED) just as human researchers do.

Mentor(s): Danielle Lucero,Physics, Virginia Tech
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Transgenerational Effects of Ethanol Exposure in Caenorhabditis elegans

Alcohol Use Disorder (AUD) is one of the most prevalent diseases in today's world, however, limited research has been done to understand the transgenerational effects of alcohol on these models and whether a parent's previous exposure to alcohol influences future generations' alcohol preference. The project's objective, therefore, is to examine how alcohol affects behaviors across generations using the C. elegans model, thereby exploring the heritability of these responses and shedding light on the potential intergenerational effect AUDs pose on offspring of these responses. C. elegans is a good model to use for this experiment due to its fast life cycle, homology to the human genome, and its use to research other neurological disorders. We conducted chemotaxis assays and preference index tests to observe ethanol impacts on C. elegans' locomotion, as motor and cognitive impairments are evident in humans when they are intoxicated. We plan to continue observing the F1 and F2 generations by measuring differences in locomotion. If we see an effect in subsequent generations, it will support our hypothesis that these locomotor effects can be passed onto generations. The importance of this experiment lies in its potential to showcase the use of this organism for translational research into Alcohol Use Disorders (AUDs) in humans. Such research could help bridge the gap in our understanding of the intergenerational effects of alcohol consumption.

Mentor(s): Jennifer Rainville, Neuroscience, Virginia Tech

Brandon Bickley
Virginia Tech/Biochemistry

Validation of the Insect Type-B Muscarinic Acetylcholine Receptor (mAChR-B) as a Novel Insecticide Target

To maintain the efficacy of chemical insecticides amidst the emergence of insecticide-resistant pest populations, it is important to identify novel molecular targets. Muscarinic acetylcholine receptors (mAChRs) are G-protein-coupled receptors (GPCRs) involved in signal transduction within the insect nervous system. Despite the success of insecticide classes targeting other cholinergic proteins, mAChRs remain an unexploited target for insecticide development. In insects, three sub-types of mAChR are known: Types-A, -B, and -C. Notably, the Type-B mAChR (mAChR-B) is pharmacologically distinct from the mammalian mAChR subtypes (M1-M5) and displays 1000-fold lower sensitivity to the agonist muscarine compared with the A-type receptor. To validate the mAChR-B as a potential insecticide target, we conducted extracellular electrophysiology experiments in Drosophila melanogaster larvae, wherein mAChR-B expression was reduced using RNA interference (RNAi). Pilocarpine, a non-specific agonist of mAChRs, had a biphasic effect on the firing rate of the central nervous system (CNS), increasing it at high concentrations while decreasing it at low concentrations. This effect was attenuated in larvae where mAChR-B expression was reduced using an RNAi system known as in vivo green fluorescent protein interference (iGFPi). Moreover, the toxicity of injected pilocarpine was lower in adult D. melanogaster in which mAChR-B expression was targeted with iGFPi. We have begun extracellular electrophysiology studies in the larvae of Anopheles gambiae, a malaria vector, to assess the potential of the mAChR-B as a target in mosquito control efforts.

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Are Commercial Microplastics An Adequate Comparison To Environmentally Realistic Microplastics?

In the science community, increased attention and funds have been dedicated to understanding the impact of microplastic occurrence and distribution in aquatic environments. Since recovering enough microplastics from the environment to understand the risk associated with exposure can be difficult and timely, labs have relied heavily on virgin microplastics from commercial suppliers. While this allows researchers to investigate the potential toxicological effects of microplastics, these particles are typically in the shape of beads or spheres. Thus, they do not reflect particles commonly recovered from environmental matrices (e.g. fragments, fibers, and films). In our study, we used the invasive Asian clam (Corbicula fluminea) to evaluate the uptake and depuration of commercial and environmentally realistic microplastics (e.g., fibers and fragments) to understand if their uptake and removal differ and if commercial microplastics are an adequate proxy. We found that there was a significant interactive effect of time and particle type on the uptake ($p = 2.3544e-07$) over 96-hour exposures (3mg/L for each plastic type). Commercial microplastics (0-55 particles/g) accumulated significantly more particles than fibers (0-4 particles/g) and crumb rubber (0-9 particles/g) in clam tissues. Environmentally realistic microplastics did not differ in uptake over time, and there was no significant difference in depuration rate among all microplastic types. Our findings highlight that while commercial microplastics present an opportunity to understand a multitude of organismal responses to microplastics, they may not adequately reflect what is occurring in the environment due to disproportionate accumulation that may overestimate the effects associated with exposure. This highlights the need to utilize environmentally realistic microplastics within laboratory assessments.

Mentor(s): Austin Gray, Biological Sciences, Virginia Tech

Nicholas Bodale
Virginia Tech/Biology

Generation of Hyperactive Mutants of the TOR Protein to Study Amino Acid Metabolism in Plants

Background and Objective: The Target of Rapamycin (TOR) Pathway is a signaling pathway that promotes cellular metabolism and growth in response to nutrient availability. TOR is a multiprotein complex and is composed of the TOR protein, Regulatory-associated protein of TOR (RAPTOR), and Lethal with SEC13 protein 8 (LST8). The aim of this study was to generate hyperactive mutants of the TOR protein in Arabidopsis plants, which provides the ability to modify plant metabolism and growth. Such a tool could later be implemented into crops to increase production.
Materials and Methods: The cDNAs from Arabidopsis encoding TOR, RAPTOR, and LST8 were cloned using the GoldenGate approach. Mutations in TOR were chosen from published results obtained in yeast and human cells, and introduced in the DNA sequence using GoldenGate. The cDNAs were placed under constitutive promoters, and the resulting constructs were expressed in Nicotiana benthamiana for functional characterization.
Results: TOR, RAPTOR and LST8 cDNAs were obtained in several steps involving amplification and cloning of sub-fragments, which enabled point mutagenesis to remove unwanted restriction sites (necessary "domestication" for the GoldenGate system), and introduce the three desired mutations in the TOR sequence (L1393P, I1922T and E2328K). All fragments were sequenced before assembly into full length cDNAs and transcriptional units. Expression and characterization are underway.
Conclusion: Cloning of TOR and RAPTOR were successful despite the length of these coding sequences (7446 and 4053 bp respectively), enabling the study of the activity of the TOR complex on amino acid metabolism in plants.

Mentor(s): Guillaume Pilot, SPES, Virginia Tech

Yuri Braga
Virginia Tech/Computer Engineering

Electrical Design of Force Sensor Interface for 3D-Printed Humanoid Robotic Platform: Pandora

Humanoid robots are increasingly being employed in various fields, from healthcare to manufacturing, requiring sophisticated sensor systems for perception and interaction with their environment. However, integrating these sensors with microcontrollers like TIVA poses challenges due to need for a standardized interface. This abstract presents the rationale and design considerations for developing a PCB sensor shield to serve as an intermediary between humanoid robot sensors and the Texas Instruments TM4C123G microcontroller (Tiva). The shield aims to provide a seamless interface for connecting a diverse array of sensors, including force sensors and rotary encoders, while ensuring efficient data transmission and processing. Key features of the shield include multiple input/output ports, voltage regulation, and signal conditioning circuits to enhance sensor accuracy and reliability. The proposed sensor shield offers a cost-effective and versatile solution for researchers and developers seeking to streamline the integration of sensors into humanoid robot platforms utilizing the Tiva microcontroller. Future work will focus on prototype testing, performance optimization, and validation in real-world robotic applications to assess its effectiveness and practical utility.

Mentor(s): Alexander Leonessa, Department of Mechanical Engineering, Virginia Tech

Justin Brandt
Virginia Tech/Sustainable Biomaterials

What is the Effect of Encased Bamboo on the Mechanical Properties of Cross Laminated Timber (CLT)?

The goal of this research project is to discover how bamboo culms, when encased between plies of three ply cross laminated timber (CLT), affect the mechanical properties of the panel. CLT panels are highly effective building materials with one fatal flaw, this being a lack of interior space to hide wiring or piping inside a wall or ceiling, due to a reduction in fireproofing ability. In order to solve this problem and create interior chases, channels were bored into pre-pressed CLT panels, and 2-inch diameter bamboo culms were fitted and glued in the open spaces. The replaced material acts as a hollow chase in the panel, allowing for wiring to be threaded through while maintaining structural integrity, due to the bamboo's natural strength. Project outcomes include devising a standardized way to mill bamboo culms, an irregularly shaped biomaterial, and the novel idea of combining two sustainable materials in order to maintain mechanical properties in a new construction method.

Mentor(s): Daniel Hindman, Sustainable Biomaterials, Virginia Tech

Maxwell Brenner
Virginia Tech/Economics

Mixed Martial Arts (UFC) Expected Round Calculator

Within the rapidly expanding field of sports betting, especially within the context of Mixed Martial Arts (MMA), bettors face a critical challenge: the lack of a centralized database containing statistical information through which they may better to inform their gambling strategies. This project aims to bridge this gap by developing an Expected Round Calculator for the UFC, designed to predict round scores and fight outcomes based on in-fight statistics, thereby enhancing betting decisions and potentially uncovering judge biases.

The research employs two primary models: the first predicts individual round scores using ordinal logistic regression, analyzing round-by-round statistics archived by the UFC and published by ESPN from UFCstats.com, and fight scorecards from MMAdecisions.com. The second model anticipates the overall fight outcome after the first two rounds, aiming to exploit live-betting market inefficiencies by comparing expected probabilities with those offered by sportsbooks.

Anticipated results include probability distributions for both round scores and fight outcomes, offering real-time insights to fighters, fans, and bettors alike. By providing a more accurate analysis of round scoring and fight predictions, the project seeks to contribute significantly to the sports betting community, enhancing decision-making processes and revealing potential biases in UFC judging. Future iterations may explore adapting the model to individual judges, further refining the accuracy of predictions.

Mentor(s): Dr. Briana Felegi, Economics, Virginia Tech

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Virginia Tech/Environmental Science

EFFECT OF DISCHARGE ON CHLOROPHYLL A AND FDOM CONCENTRATIONS ACROSS VARIOUS BIOMES

In this study, we evaluated five freshwater streams across the country and compared their fluorescence dissolved organic matter (FDOM), discharge (Q), and chlorophyll content. In doing so, we can hypothesize the effects of terrestrial carbon sequestration in these freshwater streams. We hypothesized the impacts and causes of terrestrial carbon input on freshwater stream sequestration from the data collected.
Sites include a temperate rainforest stream (Martha Creek, WA), a tallgrass prairie stream (Kings Creek, KS), a temperate deciduous forest stream (Walker Branch, TN), a Rocky Mountain stream (Como Creek, CO), and a boreal stream (Caribou Creek, AK). We concluded that each site has a variable cause and effect of terrestrial vegetation on carbon sequestration.
Further research will include evaluating carbon inputs over longer periods. This can aid in possible determinants of carbon sequestration such as the melting of permafrost due to climate change, vernal pools in high precipitation, and carbon buildup of various vegetation. These varying degrees in climate and vegetation can have diverse effects on the removal of carbon dioxide from the atmosphere.

Mentor(s): Erin Hotchkiss, College of Science, Biology, Ecology, Virginia Tech

Corrine Brown
Virginia Tech/Neuroscience
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Observing the Dopaminergic Function of C. Elegans Treated With Cannabidiol Oil

With the continuous rise of medical marijuana as a valid treatment option for disorders such as chronic pain or anxiety, as well as the decriminalization of the scheduled substance in multiple states across the country for recreational use, this research attempts to reveal a link between cannabidiol supplementation and increased dopaminergic functioning. In humans, disruptions of dopamine pathways are associated with mood and movement disorders. Using C. elegans as a model organism, we will demonstrate the effects of cannabidiol oil on dopaminergic circuitry through a learning and memory assay. If worms are administered CBD tincture synchronous with OP50 E. Coli in Luria broth, improved dopamine functioning should be observed. C. elegans were selected as the model organism because their nervous system has been thoroughly
mapped, and known to contain a dopamine and endocannabinoid receptors. Upon completion
of experimentation, significant results will provide more insight into the novelty of using cannabinoids in a therapeutic setting. Non-significant results will guide future research on the side effects of cannabinoid usage. Overall, lack of research and FDA approval of cannabidiol oil could pose risks and have unexpected side effects to consumers.

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Lucas Philput
Virginia Tech/Microbiology

Effect of Desiccation on Lichen Photosynthesis

Lichen is an organism that is composed of a symbiotic relationship between algae and fungi. Lichen is an important keystone of ecosystems because it is an incredibly resilient organism that can withstand extreme conditions, including periods of intense drought leading to desiccation. When lichen is in a desiccated state, meaning it does not have enough water, it cannot absorb sunlight. In turn, this means the lichen can neither photosynthesize nor respirate. This project sought to examine and analyze the question: does lichen retain full photosynthetic ability after dormancy? In our study, we used a species of lichen known as reindeer moss (Cladonia rangiferina), to test its photosynthetic capability before and after desiccation. We placed our lichen in sealed jars with an oxygen sensor that transmitted %oxygen through a wireless computer chip to our computers where we used Grafana and Python to (i.e., computer software) to visualize and analyze. We placed lichen in a jar in hydrated conditions and another in desiccant conditions with a desiccant pack present. In the desiccated conditions, we eventually tried to rehydrate our desiccated lichen to compare. Our results showed that the oxygen concentration in our jars was higher in the hydrated conditions and before full desiccation. After desiccation, the oxygen concentration decreased as predicted however, the lichen maintained its ability to effectively photosynthesize.

Mentor(s): Temperance Rowell, College of Science, Virginia Tech

Bridgett Burgos
Virginia Tech/Clinical Neuroscience

Role of Medication Status in the Social and Academic Profiles of College Students with ADHD

The average college student faces many stressors and responsibilities as they transition into adulthood. Previous research has suggested that college students with attention-deficit/hyperactivity disorder (ADHD) experience less academic success and greater psychological distress. Medication treatment for ADHD can have positive effects on school performance and overall well-being (Jangmo et.al, 2019).

Given this backdrop, this study sought to examine the academic, social, and employment profiles of college students with ADHD based on whether they were taking an ADHD medication. Participants were 63 college students (Mage = 20.5; 79.4% female; 42.9% freshman), 54% of whom reported currently taking an ADHD medication. Participants reported on their demographic information (employment status, involvement in Greek Life and sports, and typical grades) in spring 2022 via an online survey.

College students with ADHD on medication were significantly more likely to be involved in Greek Life and to be an athlete (55.9% and 23.5%, respectively) than those not on medication (31.0% and 3.4%, respectively); $\chi 2=3.91$ and 5.15, $ps<.05$. However, students on medication were also more likely to have some Cs than those not on medication (47.1% vs. 13.8%); students on and off medications did not significantly differ in their likelihood to be earning All As or As/Bs ($\chi 2=8.48$, $p=.01$).

Findings suggest that individuals with ADHD who are medicated may be able to do better socially in college, but that medication does not necessarily improve academic performance. This poster will discuss possible explanations for these findings and other factors that may better predict academic functioning.

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

Jenna Cain
Virginia Tech/Agricultural Technology
Brycen Sheets
Virginia Tech/Agricultural Technology

Stockpiled Fescue Yield and Quality Responses to Nitrogen Fertilizer

The basis of our research is to compare and determine the responses of nitrogen fertilized and unfertilized stockpiled tall fescue in relation to yield and nutritional value. We are also hoping to learn about the mineralization of organic N from cattle excrement to determine if the application of commercial N is beneficial. We used a simple four by four plot design with four treatments and four replicates. This will give us the most accurate results we hope to achieve. The group predicts the fertilized areas will show a yield increase, but not a nutritive response.

Mentor(s): Wesley Gwantley, CALS, Virginia Tech

Justine Campbell
Virginia Tech/Biochemistry
Maddie Flake
Virginia Tech/Biochemistry
Logan Hicks
Virginia Tech/Biochemistry
Fang Huang
Virginia Tech/Biochemistry

Investigating Binding Efficiencies of Various Opioids to the μ-Opioid Receptor

Opioid abuse is a prominent issue in today's world. According to the CDC, in 2021, there were approximately 106,000 deaths due to opioid overdose in the U.S. alone. The μ-opioid receptor is the primary binding site for opioids such as oxycodone, fentanyl, and morphine. However, the addictiveness of these opioids varies. Here, this work seeks to determine the impact of differences in opioid structure to their binding affinities. Molecular docking was performed to compare the predicted binding affinities of these commonly prescribed opioids such as fentanyl, oxycodone, morphinan, hydrocodone, morphine, codeine, hydromorphone, oxymorphone, methadone, and tapentadol. Of the opioids tested, fentanyl had the strongest affinity at -8.9 kcal/mol, and tapentadol had the weakest affinity at –6.3 kcal/mol. A contributing factor to the more favorable binding affinity of fentanyl is hydrogen bonding interactions with the His297. The more favorable binding affinity can be an explanation for why fentanyl is so addictive, though other factors can influence addictiveness such as genetics and dosage. It is essential to understand how opioids bind to the μ-opioid receptor because it can lead to more research into how to manufacture different drugs that are less addictive and safer than opioids like fentanyl.

Mentor(s): Anne Brown, University Libraries, Virginia Tech

Natalie Cann
Virginia Tech/Microbiology

Vector competence of Aedes albopictus for vertical transmission of La Crosse virus

Vector-borne pathogens are an important cause of human disease and are of public health concern. With increasing temperatures, the geographic ranges of vectors have increased, which could lead to changes in the transmission of vector-borne diseases. La Crosse virus (LACV) is one such pathogen that is prevalent in the Midwest and Appalachian regions of the US. LACV is generally transmitted by the native mosquito, Aedes triseriatus, but there is evidence that Aedes albopictus, an invasive vector, is implicated in transmission. A previous study in our lab has indicated that increases in temperature influence horizontal transmission of LACV in Ae. albopictus; here we will explore the role of temperature on vertical transmission. Briefly, female mosquitoes will be maintained at 29°C and presented with a LACV-infected bloodmeal. Engorged mosquitoes will be maintained for 7 days and then presented with a non-infectious bloodmeal to prompt oviposition (egg laying). Parent mosquitoes will be housed singly, allowed to oviposit, and the subsequent eggs reared to adulthood then screened for virus presence. Transmission rates determined from this study will be compared to previous data at 26°C to assess the influence of temperature. Vertical transmission can be a maintenance mechanism for viral persistence; thus important to understand.

Mentor(s): Gillian Eastwood, Entomology, Graduate Student, Virginia Tech
Lindsey Faw, Entomology, Virginia Tech

Catherine Carrion
Virginia Tech/Fish Conservation

Evaluating Examples of Indigenous Turtle Use and its Legality

Indigenous people have traditions that have been passed on through generations, including turtle use and consumption. When deciding how turtles should be used and managed, indigenous people's needs, and traditional practices should be considered. With new laws being put into place to protect the declining turtle species, it is crucial to consider how these laws might affect those who have relied on turtle products for millennia. We performed a systematic literature review to understand how indigenous turtle use practices differ across countries, and compare the legality associated with turtle use among countries. We also aimed to see how many countries considered the indigenous usage of turtles when passing new legislation. Using Covidence, a collaborative literature review software, we found 294 published studies related to global drivers of turtle trade that underwent a full-text review. Of these, 217 studies were excluded as they did not meet inclusion criteria for relevancy to research objectives. Themes relevant to indigenous turtle use and legality were then extracted from 35 of the remaining 77 studies. From the papers that included legality information, we found that turtle consumption and usage laws are challenging to interpret. Indigenous uses for turtles differ, including for currency, food, religion reasons, among others. These diverse uses highlight why wording the legality of turtle usage can be challenging. In the future, researchers should strive to include indigenous perspectives in their evaluation of wildlife trade drivers, conservation initiatives, and compliance to wildlife legislation on a global scale.

Mentor(s): Willandia Chaves-Didier, Fish and Wildlife Conservation, Virginia Tech
Zoie McMillian, Fish and Wildlife Conservation, Virginia Tech

Gabrielle Carter
Virginia Tech/Biological Sciences

Arabidopsis thaliana AAP6 involvement in response to Phytophthora capcisi infection

Phytophthora is a genus of oomycetes (water molds) that contains deadly crop pathogens that pose a serious threat to global food security. Our working model of plant defense against oomycete infections includes amino acid relocation from leaf mesophyll cells to root tissue via vascular transport, to deprive the leaf pathogen of nutrients necessary for growth. This mechanism involves an amino acid transporter (Amino Acid Permease 6, AAP6) that could translocate amino acids from leaf cells into the phloem for relocation into the roots. Our lab has obtained evidence that this nutrient restriction mechanism enhances resistance to foliar infections, but the effect of this response on root infections remains to be explored. The aim of my experiment was to investigate Arabidopsis thaliana AAP6 involvement when exposed to root pathogen Pythopthora capcisi. This was done through two experiments: a nitrogen allocation and a reporter gene experiment. In both, A. thaliana was grown hydroponically and inoculated with P. capcisi zoospores. In the nitrogen allocation experiment, wild-type and AAP6-mutant lines of A. thaliana were grown and shoot and root tissue was collected 0-, 24-, 48-, and 72-hours post-inoculation. Samples were then dried and the percent nitrogen of each was obtained through elemental analysis. In the reporter gene experiment, transgenic lines of A. thaliana expressing an AAP6 GFP or AAP6 GUS reporter gene were used. The time course for sample imaging was 6-, 24-, 48-, and 72-hours post-inoculation. We will present and interpret preliminary results from these experiments in the context of our working model.

Mentor(s): John McDowell, School of Plant and Environmental Sciences, Virginia Tech

Nathanyal Carter

Virginia Tech/Electrical Engineering

Using Virtual Reality To Do CITI Training

Researchers are responsible for conducting exceptional science while protecting participants from physical and psychological harm. To do so successfully, researchers at all levels are required to obtain Institutional Review Board approval for all research activities. Virginia Tech utilizes the Collaborative Institutional Training Initiative (CITI) program to provide educational material and facilitate the management of research-related certifications; however, it is time-consuming and can be disengaging leading to the possibility of reduced knowledge retention and quiz retakes which further exacerbates the problem. This study aims to determine to what extent virtual reality (VR) can improve user experience associated with CITI training; more specifically, the Financial Conflict of Interest certificate. The study uses a within-subjects design to investigate two levels of CITI training presentation formats (computer-based vs. VR-based) on user experience defined by cognitive workload, knowledge retention, engagement, and comfort. Objective measures of knowledge retention are gathered through post-training quiz results while subjective measures are captured in two forms: cognitive workload using the NASA TLX and engagement and comfort using post-study QuestionPro questionnaires. Additionally, the overall time to completion is measured. Data collection is ongoing; however, results are expected to show a significant difference between presentation formats associated with overall user experience. T-Tests will evaluate the difference between presentation formats for each dependent measure. In sum, VR provides a novel way of completing research training that has the potential for a more efficient, engaging, and enjoyable experience.

Mentor(s): Rafael Patrick, Department of Industrial Engineering, Virginia Tech

Matilda Cashman
Virginia Tech/Biological Sciences

Assessing changes in flowering phenology of native southern Appalachian medicinal plants in response to climate change

Flowering plants are blooming earlier in many regions around the United States. This shift in flowering phenology has been attributed to the effects of climate change, specifically warming springtime temperatures. Warmer temperatures during a plant's blooming season can disrupt the plant's natural rhythms and responses to environmental cues, leading to a shift in bloom time. This change means that these species may be experiencing a loss of suitable habitat. This project focuses on flowering plants with medicinal importance to the culture of the southern Appalachian region, as this area is both understudied in phenology research and is relevant to Virginia Tech's land-grant mission. To quantify phenological differences, wild occurrence data for several species were retrieved from the Global Biodiversity Information Facility (GBIF), and the included images were categorized on a five-point phenophase scale to identify blooming stage. Using multiple regression analysis, these phenophases will be compared against the corresponding temperature data for the region to identify phenotypic trends for each plant species. In nearby regions, most plants are blooming earlier on average. We expect that our results will follow the trend of earlier flowering time correlating with warming springtime temperatures. Assessing flowering phenology over time is critical for understanding how the flora of this region is adapting to warming temperatures. Knowledge of this phenological shift is essential due to the cultural significance of these medicinal species in southern Appalachia.

Mentor(s): Jordan Metzgar, Biological Sciences, Virginia Tech

Lily Casteen
Virginia Tech/Wildlife Conservation

Angler attitudes toward longnose gar in Virginia's recreational fisheries: Ecological outcomes and management implications

This project establishes a baseline understanding of an emerging recreational fishery that targets widely distributed and understudied longnose gar (Lepisosteus osseus) in Virginia's James and Rappahannock rivers. We are analyzing 32 years of data collected by Virginia's Department of Wildlife Resources (DWR) on LNG abundance (catch per unit effort, CPUE), and length-weight relationships (condition, K) to document changes in populations over time on the non-tidal upper and middle portions of the James and Rappahannock rivers, above their fall lines. Our analysis compares patterns of CPUE and K for LNG both spatially (in the upper vs middle portions of the river) and temporally (from 1991 - 2023). We are also conducting interviews with anglers fishing at sites across these drainages to document attitudes and perceptions of LNG in these systems, and to understand current and previous prevalence of and propensity for the emerging practice of bowfishing for LNG in both rivers. The specific objectives of this research are to 1) evaluate LNG abundance and condition at different sites on the James and Rappahannock rivers, 2) assess angler attitudes toward and treatment of LNG and perceptions of value and 3) assess potential threats to the LNG in Virginia posed by the largely unregulated and high-mortality bow fishery. Longnose gar are not regulated as a game species in Virginia, and characterizing the fishery in the James and Rappahannock Rivers has the potential to influence future management actions.

Mentor(s): Elizabeth Nyboer, Fish and Wildlife Conservation, Virginia Tech

Rachel Castro
Virginia Tech/Cognitive and Behavioral Neuroscience

EARLY CHILDHOOD PREDICTORS OF ADHD: EXPLORING THE ROLE OF INFANT DISTRESS, CHILDHOOD IMPULSIVITY, AND MATERNAL NEGATIVITY

Child and maternal factors respectively impact ADHD symptoms (McLaughlin & Harrison, 2006). Stressful life events serve as predictors for ADHD symptoms (Vrijsen et al., 2017). Evidence suggests higher impulsivity levels correlate with child ADHD diagnoses (Figueiredo et al., 2018). We assessed whether maternal negativity mediated the relationship between childhood distress at 5 months and childhood impulsivity at 24 months with children's ADHD at 36 months.

Infant distress was collected via the IBQ. Childhood impulsivity was maternally reported via the CBQ. Childhood ADHD was maternally reported via the CBCL. Two mediation analyses via SPSS 26 were conducted. The first examined the relationship between infant distress at 5 months, maternal negativity at 24 months, and ADHD symptoms at 36 months in 187 participants. Greater 5-month infant distress was directly related to more 36-month ADHD symptoms ($b = .466$, $p = .043$) and indirectly predicted 36-month ADHD via greater 24-month maternal negativity ($b = .033$, $p = .030$) which related to more 36-month ADHD behaviors ($b = 2.22$, $p = .044$).

The second analysis examined the relation between childhood impulsivity at 24 months and ADHD symptoms at 36 months in 189 children. Greater 24-month impulsivity was directly related to more 36-month ADHD symptoms ($b = .702$, $p = .016$) and indirectly predicted 36-month ADHD via greater 24-month maternal negativity ($b = .074$, $p < .001$) which related to more 36-month ADHD behaviors ($b = 2.23$, $p = .029$). Results indicate the importance of assessing direct and indirect child and maternal factors for ADHD behaviors in early childhood.

Mentor(s): Mohamed Zerrouk, Psychology, Virginia Tech
Martha Ann Bell, Psychology, Virginia Tech

Annay Chakravorty

Virginia Tech/Managerial Economics and Data Science

Economic Analysis of the ARPA-E Program on College Majors

Industrial policy has been used as a key component to spur growth in specific sectors of the economy for several decades. Despite this importance, we have little understanding of its potential impact on education. In this project, I aim to provide an economic analysis of such industrial policy on its impacts on college majors, future and current. The ARPA-E program was created by the Department of Energy in order to fund technology-focused, applied research and development aimed at creating real-world solutions to important problems in energy creation, distribution, and use. The goal of this project is to determine whether the massive funding of this program has any effect on enrollment of STEM majors in surrounding 2-year, degree-granting institutions. All of these projects were conducted in order to develop solutions within various STEM problems, thus we are trying to quantify an effect on enrollment of STEM majors. These findings could have a large impact in the understanding of future employment outcomes. Data was collected from the ARPA-E website as well as numerous surveys on all federally funded 2-year schools in the United States. Subsequently, a difference-in-difference technique will be used to uncover a true casual effect on STEM major enrollment at 2-year, degree-granting institutions before and after the year the first program was funded at each institution and its respective county. A main anticipated result would be an increase of the enrollment in STEM majors at 2-year, degree-granting institutions because of the ARPA-E program. We can expect these projects that are being funded to gain traction within the surrounding community, which will incentivize first-year students to major in such STEM areas.

Mentor(s): Brianna Felegi, Economics, Virginia Tech

Aspen Chamberlain

Virginia Tech/Environmental Resources Management

Impact of Leaf Litter on the Water-Staining Process

Wetlands are often identified and delineated using field observations of key diagnostic properties. The presence of water-stained leaves is a primary indicator and are reported in >25% of indicators for wetland hydrology. Several studies published by the US Army Corps of Engineers reported formation timeframes of water-stained leaves concerning wetland delineation hydrology indicators. While their research targeted leaves experiencing natural abscission on tree branches, they failed to include leaves that have already begun the natural land decomposition process. This study aims to explore the rate at which leaf can be classified as water-stained in compliance with US Army Corps of Engineers Eastern Mountains and Piedmont Supplement standards. Understanding the rate that leaf litter becomes water stained gives insight to the amount of time wetland hydrology has been present for a proper delineation. The Munsell color chart which identifies color by hue, value, and chroma numerically assigns value to the leaf litter as it experiences water-staining. Leaf litter in a variety of simulated wetland variables including light, temperature, water saturation, and sediment accumulation formulates a realistic water-staining process for a majority of leaves already fallen to the ground. It is hypothesized that the rate of water-staining in leaf litter will be much faster than leaves experiencing natural abscission which correlates to a lower Munsell color chart number. Analyzing leaf litter is the most relevant leaf form type as most leaves undergoing the water-staining process have long fallen to the ground and experienced some form of degradation.

Mentor(s): Brian Strahm, Forest Resources and Environmental Conservation, Virginia Tech

Keya Chava
Virginia Tech/Psychology

Investigating Differences in How Verbal Behavior Relates to Self-Reported and Observer-Rated Personality Traits

This study examines the relationships that verbal behavior exhibits with self- and observer-reported HEXACO personality. By doing so, the study advances understanding of the manifestation of self-reported personality (i.e., identity) versus the evaluation of personality (i.e., reputation) in employment settings. To do so, 653 participants completed a mock job interview, self-reported their HEXACO traits, and had their HEXACO traits evaluated by 3-4 observers who reviewed the interview recording. Verbal behavior was operationalized using Linguistic Inquiry and Word Count (LIWC). The findings reveal discrepancies in how self and observer ratings relate to verbal behavior, and we use the Brunswick Lens paradigm to illustrate these relationships. Self-reported openness, agreeableness, extraversion and emotionality traits show moderate correlations with health (e.g. clinic, flu), death (e.g. bury, coffin), and clout (language reflecting status), as well as word count. However, observer ratings tend to correlate with different verbal behaviors and do so more strongly than self-reported traits do, indicating divergence between how personality manifests verbally compared to how it is evaluated by others. This study illustrates the multifaceted nature of personality, given the low convergence between self- and observer-reports, as well as their distinct relationships with verbal behavior. The findings hold practical relevance for areas such as interviews and other professional contexts, including recruitment, selection and performance evaluation, where accurate assessment of personality traits is essential. Additionally, these insights could serve as valuable resources for coaching and mentoring interviewees.

Mentor(s): Louis Hickman, Psychology, Virginia Tech

Ryan Chen
Virginia Tech/Packaging Systems and Design
Ray Flannagan
Virginia Tech/Packaging Systems and Design
Matthew Simmons
Virginia Tech/Packaging Systems and Design
Joe Barrese
Virginia Tech/Sustainable Biomaterials

Waste Not: The potential for value-retention through diversion and recovery.

Strategies to reduce waste generation and increase recycling activities represent a common, economically efficient, and often regulated opportunity for businesses to engage in more sustainable operations. This study aimed to conduct materials characterization and energy audits across three retirement communities located throughout Virginia to assess current state practices and identify opportunities for improved materials management. Waste and recycling materials generated over 48 hours were collected at each facility, and then our teams sorted, characterized, and recorded for composition and weight across 36 material categories: Results indicated multiple opportunities for facilities to improve their sustainability practices through enhanced waste diversion techniques. Across all facilities, an estimated 13.8 tons of recyclable materials were misdirected to landfills each year. Interventions such as increasing the education of staff and residents, choosing more sustainable materials, and increasing access to recycling, may help to reduce the volume of recyclable materials sent to landfills and their associated costs. Addressing food waste in these communities by introducing composting and reducing serving sizes could reduce compostable waste sent to landfills by an estimated 45.8 tons annually. Addressing waste habits will significantly reduce hauling costs and overages, with increased recycling and composting simultaneously reducing the company's carbon footprint.

Mentor(s): Jennifer Russell, Department of Sustainable Biomaterials, Virginia Tech

Ryan Chen
Virginia Tech/Packaging Systems and Design
Matthew Simmons
Virginia Tech/Packaging Systems and Design
Bethlehem Yemane
Virginia Tech/Packaging Systems and Design

Study to Enable the Wide Adoption of Fiber-Based Insulation in Passive Shipping Containers

Cold chain shipping containers are difficult to construct sustainably. Due to the need for pharmaceuticals to maintain a specific temperature range to ensure product safety, there are challenges for the development of sustainable coolers. This research project aims to determine the connection between the thermal resistivity of packaging materials in a heat flow meter and when acting as insulation in a shipping cooler. This entails the construction of insulated shipping containers with the components being insulation material, gel packs acting as passive cooling, as well as the product being transported. These coolers were tested using a chamber capable of simulating real-world shipping conditions. The insulation material is then tested for its thermal resistivity values and the performances are compared. Coolers stayed within the range of 2-8 degrees Celsius for approximately 20 hours or more for most of the tested units. When innovating in the space for cold chain shipping, new materials have to go through rigorous testing that can be reduced if a standard measurement or guideline for the performance of the material is established. Once testing is completed, further analysis of the materials with processes such as Life Cycle Analysis can be done. Overall, this project aims to provide a guideline for determining a material's viability regarding thermal insulation, sustainability, and shipping performance.

Mentor(s): Eduardo Molina, Department of Sustainable Biomaterials, Virginia Tech

Jolie Childress
Virginia Tech/Nutrition and Dietetics
Eudora Nordt
Virginia Tech/Psychology
David Lee
Virginia Tech/Psychology

Maternal Parenting, Child Effortful Control, and Academic Skills Across Early Childhood

Effortful control (EC) is associated with academic skills in children (Valiente et al., 2013). Some have shown EC to only be correlated with math skills, but not other crucial academic skills like reading (Ernst et al., 2022). This could be explained by maternal behaviors, which have been shown to affect child EC, math, and reading (Clark et al., 2015). We sought to examine these associations in our current study to help lend to this understanding.

Mother-child dyads (n = 160) were assessed when children were 4- and 6-years-old. At age 4, mothers reported on EC (MR-EC) using the Child Behavior Questionnaire (Rothbart et al., 2001), EC was assessed with a lab task (LA-EC), and maternal behaviors of directiveness (mDIR) and intrusiveness (mINT) were coded by researchers. At age 6, child math and reading were assessed using the Woodcock-Johnson III Tests of Achievement (Woodcock et al., 2001).

Bivariate correlation was used to examine the associations. MR-EC was correlated with math ($r = .22$) and reading ($r = .19$) skills. LA-EC was not associated with academic skills, but it was correlated with both mINT ($r = -.17$) and mDIR ($r = -.15$). mDIR was also correlated with math ($r = -.23$). All ps were less than .05.

These results suggest that more MA-EC is adaptive for academic outcomes, more mDIR is maladaptive for such, and that maternal behaviors might influence performance on LA-EC. Future work should continue to examine the importance of EC and maternal parenting on child academic outcomes.

Mentor(s): Martha Ann Bell, Psychology, Virginia Tech
Jennifer J. Phillips, Psychology, Virginia Tech

Emma Cleveland
Virginia Tech/Systems Biology
Allison Pennington
Virginia Tech/Biochemistry

Characterizing Oligomeric Amyloid-β42 and POPC Interactions Through Molecular Dynamics: A Computational Approach for Understanding Alzheimer's Disease

Alzheimer's Disease (AD) progresses due to the formation of senile plaques primarily composed of amyloid-β42 (Aβ42) aggregates. Aβ42, the principal toxic species of AD, induces cytotoxicity through oligomerization and interaction with neural membranes. This results in destabilization and ion leakage escalated by free lipids, facilitating the cell membrane penetration of Aβ42 peptides, leading to further perturbation and apoptosis. 1-palmitoyl-2-oleoyl-sn-glycero 3-phosphocholine (POPC), abundant in cell membranes, is a model free lipid used for studying peptide-lipid interactions, however the dynamics of Aβ42 and POPC have yet to be characterized at the concentrations in this study. Molecular dynamics (MD) simulations were conducted to investigate and characterize the aggregation and structural morphologies of hexameric, octameric, and decameric Aβ42 with and without POPC. System analysis indicated Aβ42 residues 16-22 and 30-35 associated with the aliphatic chains of POPC. The observed increase in β-strand secondary structure suggests a possible correlation with advancing aggregation, aligning with the pathogenesis of insoluble fibril formation. Preliminary results further suggest that systems with POPC demonstrate more structurally defined aggregates than systems lacking free lipids, suggesting that the hydrophobic interactions with POPC contribute to aggregation. Through investigating the atomistic dynamics of POPC and Aβ42, this study aims to provide a greater understanding of AD pathology and prevention.

Mentor(s): Anne Brown, University Libraries, Virginia Tech

Truman Collins
Virginia Tech/Wildlife Conservation

Factors influencing occupancy and detection of margays (Leopardus wiedii) in tropical broadleaf forest versus a unique tropical pine forest in Belize, Central America.

The margay (Leopardus wiedii) is a small (5-9 lbs), semi-arboreal felid native to the Neotropics with extremely scant information on its spatial and behavioral ecology. There are many camera-trapping studies in the neotropics aimed at studying the jaguar including the study we used, the Ix Jaguar Project started in 2001. This is a large-scale, long-term camera-trapping project. While remote camera trapping methods are used to study population dynamics of the large cryptic species, they also inadvertently capture 'bycatch species' due to the cameras, motion, and heat-activated sensors. Using abiotic and biotic covariates, we used an occupancy modeling approach within a maximum likelihood framework to explore factors influencing margay distribution. We used by-catch data for margays from 10 years in northern Belize (4 study areas) and the Mountain Pine Ridge Forest Reserve (southern Belize) from over 190 camera stations covering protected and private areas from ~2000 km2 to ~556 km2. We found occupancy ranging from 0.32-0.64 over time while detection varied across the years and study sites. Top models often did not have factors that strongly influenced occupancy or detection parameters due to low detection rates. Future studies should aim to create nested camera trapping grids to increase detection rates and focus on density estimates using the margay's unique spot patterns, allowing land managers to better include margays in conservation practices.

Mentor(s): Marcella Kelly, Wildlife Conservation, Virginia Tech

Olivia Cox
Virginia Tech/Psychology

Educating Adolescents about Neuroscience and the Effects of Substances on the Brain

Adolescent substance use is a problem nationwide. Programs that rely on promoting neuroscience education instead of stigmatizing messages have potential to reduce adolescent substance use. For example, Just Say Know (Meredith et al., 2021) is a substance use prevention program that teaches teens how substances affect their brains with promising results. Our team updated the program and integrated it within a full day fieldtrip to add hands-on demonstrations to further teach teens about the effects of substances on their brain. For this study, we aimed to assess if engaging in the JSK fieldtrip led to increased knowledge about the neuroscience underlying substance use problems and participant intentions to reduce or delay substance use. Ninth graders (N=37) participated in the "JSK Fieldtrip" at Virginia Tech, where they attended 2 of 3 stations: MRI, Neuro, and JSK. Participants completed a paper-and-pencil survey about attitudes toward substances (5 items), pre-/post-neuroscience knowledge (8 items), and fieldtrip feedback (3 open-ended items). Results from a mixed-method ANOVA found that all participants improved in their neuroscience knowledge from pre- to post-, JSK and MRI group (Δ=1.9), MRI and Neuro group (Δ=1.688), and JSK and Neuro group (Δ=.455). Most participants noted that they were somewhat more likely to delay or reduce substance use (81.1%) and somewhat less likely to choose friends who used substances (91.9%), with no significant differences by group. Qualitative feedback indicated a need to make the JSK program more interactive. Findings indicate substance use programs that utilize neuroscience education elicit a positive response from participants.

Mentor(s): Samantha Kempker-Margherio, Psychology, Virginia Tech

Audrey Craig
Virginia Tech/Economics

Upward Bound

Upward Bound is a federally funded program rolled out during President Johnson's "War on Poverty" in 1965. The program aims to enhance the opportunities for lower-income families to pursue post-secondary education through resources such as tutoring, test preparation, and fee waivers. The goal of this project is to determine the short and long-run impacts of Upward Bound on education and various socio-economic outcomes. The empirical strategy used is a difference-in-differences technique analyzed through Stata statistical analysis software. The treated group are individuals exposed to the Upward Bound program in their county by age 14, and the control group are those not exposed to the Upward Bound program by age 14. The purpose of this study is to determine the effects before and after the Upward Bound program was implemented in affected counties, on both the outcomes of individuals who received the benefits of the program as well as their children. The hypothesis of improved outcomes for both generations of Upward Bound can be attributed to its transmission of educational values and resources, potentially leading to positive socio-economic trajectories across generations. I anticipate that living in a county with an Upward Program at age 14 will be associated with increased educational and socio-economic outcomes including high levels of education completed, lower incarceration rates by age 40, and higher levels of employment in both the first and second generation.

Mentor(s): Brianna Felegi, Economics, Virginia Tech

Noah Crook
Virginia Tech/Geosciences

Vendotaenia as a Classic Example of Disaster Taxa at the Ediacaran-Cambrian Boundary

The Ediacaran-Cambrian Boundary (~538.8 million years ago, Ma) represents a critical transitional period in the evolution of life. This transition was preceded by an extinction event 550 Ma and another occurring at the boundary itself. These two pulses bracket the Kotlinian Crisis, marked by an observed drop in the diversity of life and the disappearance of many unique taxa. Some taxa, however, have been perceived to have survived and even thrived during the crisis. Vendotaenia is one such organism but this perception has never been supported quantitatively. We quantitatively document specimens of Vendotaenia in drill core samples from Namibia's Nama group, a geologic unit spanning the Ediacaran-Cambrian boundary, using light and scanning electron microscopy to address its taxonomic affinities and 3-dimensional morphology. We conclude that the Nama population of Vendotaenia represents a single species of tubular macroalgae that were likely planktonic in nature. Due to their abundance, low diversity and temporal occurrence, Vendotaenia is here considered to represent a classic example of a disaster taxa–organisms that thrive in response to periods of biological upheaval. The occurrence of a disaster taxon in the late Ediacaran is consistent with the expectation of the Kotlinian Crisis, mirroring the characteristics of Phanerozoic mass extinctions: the extinction of many organisms, the brief flourish of disaster taxa, and the emergence of a new cohort of life.

Mentor(s): Shuhai Xiao, Geosciences, Virginia Tech

Grace Crowe
Advanced Studies Blacksburg High School Student

Study of Conservation in Virginia using Bobwhite Quail as an Indicator Species.

Nationwide the Bobwhite quail population has been in decline for nearly six decades. There have been conservation efforts most of this time, however, it has not had a significant enough effect. Loss of habitat is the most predominant reason for the population numbers. The farming industry has a significant effect due to its large acreage. Horticulture farming is not focused on in this study as there is little opportunity for change in the industry. In Virginia, the livestock fields are almost all monocultures of imported, invasive, and cold-season grasses. Almost half of Virginia is in the fescue belt. The region is named for its high almost all-encompassing levels of tall fescue. Tall fescue is a smother, cold season grass that farmers graze livestock on and is grown for hay production. Tall fescue provides nothing for native habitat and is also not the most effective grass to graze (when in a monoculture). Studies have shown that grazing on native warm season grasses (NWSG) is more beneficial and brings in more money per head of cattle, they are also the most prominent aspect of quail's habitat. Farmers have shown a hesitance to switch field composition completely due to the common process (burning) and would lose money on the switching field until the grasses are switched. This short-term cost is too much even for the long-term benefit. An integration of NWSG with current grasses could provide quail with the habitat they need while also making the processes available and accessible to most if not all farmers. The integration would keep the benefits of tall fescue, mitigate the negatives, and profit from the positives of grazing NWSG too.

Mentor(s): Katharine Davis, Advanced Studies Blacksburg High School

Charlotte Cullen
Virginia Tech/Cognitive & Behavioral Neuroscience
Bella O'Brien-Gonzalez
Virginia Tech/Human Nutrition Foods & Exercise (HNFE)
Keara Sosa-Ton
Virginia Tech/International Relations

Climate Action Living Laboratory Framework at Virginia Tech: Community-Engaged Service Learning in Practice

In reaction to the global climate crisis, universities stand poised to be essential changemakers. Virginia Tech has embraced this challenge by developing the Climate Action Living Laboratory (CALL), in alignment with goal 10 of the 2020 Virginia Tech Climate Action Commitment (VT CAC). The CALL aims to integrate students and faculty with staff to achieve the goals of VT CAC through a collaborative framework combining transformative research, education, and service to build a sustainable and equitable future for our campus and surrounding community. In Fall 2023, students in the UH 3204: Honors Service Learning course collaborated with the Office of Sustainability to develop this CALL framework through three projects: Benchmarking and Priority Alignment, Communications Planning, and a Showcase. Benchmarking and Alignment identified 10 U.S. peer institutions with living laboratory programs, based on four of Virginia Tech's top priorities aligning with CALL values. The Communications Plan developed a CALL Communications packet containing a creative brief, communications outline, graphic/slogan ideas, and other key elements to effectively communicate the CALL to the Virginia Tech community. Finally, students created a planning packet, including all major logistical details for a CALL Showcase event in April 2024, celebrating the development of a more formal CALL framework and other CALL-relevant teaching, research, and service activities at VT. These projects played a key role in developing the CALL's framework, providing an example of community-engaged service and transdisciplinary learning opportunity as a foundation for future partners to build upon.

Mentor(s): Rachael Budowle, Honor's College, Virginia Tech
Kristina Cook, Campus Planning, Infrastructure, and Facilities; Virginia Tech
Nathan King, Climate Action, Energy, and Sustainability; Virginia Tech
Jack Leff, Climate Action, Energy, and Sustainability; Virginia Tech
Emily Vollmer, Office of Sustainability; Virginia Tech, Virginia Tech

Erik Cumpston
Virginia Tech/Biological Sciences (EEB)

Cannabinoid Cultivar Study

Title: Cannabinoid Cultivar Study

Co-authors: Erik Cumpston, Morgan Haymaker, Melissa A. Burt, and Susan R. Whitehead

Due to the recent expansion in industrial hemp production, the presence of insect pests associated with hemp crops are becoming increasingly prevalent. Increasingly so, larval stage Lepidopteran pest insects have been negatively affecting industrial hemp farms. A prime example of this is the corn earworm, Helicoverpa zea. We conducted a bioassay analyzing the effect of a certain cannabinoid of hemp cultivars called “Wife” extract on H. zea during the Spring of 2024. We measured development of H. zea across three different diet treatments: a control diet with water, a control diet with ethanol, and an experimental diet with a extract from a cannabinoid cultivar. Growth of H. zea on the cannabinoid treatment diet was stunted when compared to the control diets. The larvae developed much slower and took longer to pupate. Additionally, the pupae reared on the cannabinoid diet treatment weighed much less than the individuals on the control diets. Analyzing the interactions that a pest organism, like H. zea, has with different cannabinoid cultivars is beneficial on a broader scale, when interpreting how other Lepidopteran pest insects may affect hemp crops in an industrial setting. Understanding the bioactivity of these insect pests when they consume different cannabinoid cultivars will lead to better management practices of hemp crops.

Mentor(s): Morgan Haymaker, COS, Virginia Tech

Sarah Cunningham
Virginia Tech/Cognitive and Behavioral Neuroscience and Psychology

The Association Between Internalizing Symptoms and Sleep Behaviors in Adolescents with and without ADHD

Sleep difficulties are common in adolescents, with adolescents with attention-deficit/hyperactivity disorder (ADHD) being more likely to experience internalizing disorders and sleep problems. Existing research supports the link between adolescent anxiety and sleep problems; however, limited research has investigated the association between depression and sleep problems. This study examined the prevalence and stability of internalizing symptoms and sleep problems from 8th-10th grade, and whether ADHD status moderated the association between internalizing symptoms and sleep behaviors.

The sample includes 302 adolescents (162 with ADHD; 167 males; 247 White-identifying; Mage=13.2). Measures include the Revised Child Anxiety and Depression Scale, adolescent-reported Sleep Habits Survey, and parent-reported Sleep Disturbance Scale for Children, with a focus on daytime sleepiness and sleep-wake problems.

Anxiety and depression symptoms remained stable over the two-year period, with 4.5-7.5% of adolescents falling in the clinically significant range. Adolescents with ADHD had significantly more depression symptoms than adolescents without ADHD but did not significantly differ on anxiety. Depression symptoms remained a robust predictor of sleep problems in 8th and 10th grade controlling for anxiety symptoms and ADHD status. ADHD status significantly predicted self-reported sleep-wake problems in 10th grade only. There was no evidence of ADHD status moderating the association between internalizing symptoms and sleep problems.

Findings suggest that depression and ADHD, but not anxiety, are unique predictors of sleep problems. Treating depression and ADHD through pharmacological and behavioral therapy approaches may help reduce adolescent sleep problems. Future research should explore bidirectional associations between symptomatology and sleep problems, as well as treatment effects.

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

Evelyn Dana
Virginia Tech/Biological Sciences
Isabella Korobow-Velez
Virginia Tech/Biological Sciences

Assessing Macroinvertebrate and Primary Producer Populations and Their Habitats Across Biomes

To assess community structure of stream food webs, we analyzed data regarding populations and habitats of primary producers and macroinvertebrates at two stream sites, King Creek, KS (KING) and Martha Creek, WA (MART) over a period of four years (2019-2022). MART is located in a temperate rainforest climate, and KING is located in a tallgrass prairie. We used RStudio to download and analyze data collected by the National Ecological Observatory Network (NEON).

The primary producers at MART were characterized by vascular plants and moss while KING contained mostly algae. Dominant primary producers at MART and KING were Ulothrix and Spirogyra, respectively. Substrate data was analyzed, and we found MART to have more pebble and cobble as opposed to KING which had pebble mixed with sand and silt. We theorize this to be a contributor to distinct primary producer groups at MART versus KING. The dominant macroinvertebrate at both sites was Diptera. The sampled macroinvertebrates showed a higher quantity at MART over KING and more diversity in taxa present. The macroinvertebrates were mostly found in riffle and pool habitats at both sites.

Future research will include more in-depth analyses of macroinvertebrate and primary producer populations over time to establish a relationship between the communities. We aim to achieve a better understanding of population fluctuations and link with in-stream gross primary production (GPP) at both sites.

Mentor(s): Erin Hotchkiss, Biological Sciences, Virginia Tech

Karina Daniel
Virginia Tech/Psychology
Audry Rush
Virginia Tech/Psychology and Criminology
Jada Theodore
Virginia Tech/Psychology and Sociology
Charlotte Cunningham
Virginia Tech/Psychology

Practical Interventions to Decrease the Use of Plastic Bags; Behavioral observations at two large grocery stores

Without large-scale behavior change, the annual flow of plastic into the ocean will triple over the next 20 years, limiting climate regulation of the ocean and severely harming ecology. Unfortunately, most grocery-store customers choose single-use plastic bags over reusable bags. Baseline data from January 2022 to March 2024 was attained by trained undergraduate researchers who systematically observed the type of bags (plastic, paper, or reusable) used by patrons upon exiting two large grocery stores, as well as other relevant variables. Baseline results indicated that around 75% of 30,392 observed customers used plastic bags for their groceries. Discrepancies were found across gender and age groups as data was updated, which will be further discussed in the poster. The first intervention involved prompting and feedback by placing large posters at the entrance/exit of the two grocery stores, with the phrase “Hokies, Choose to Reuse!” and posting the percentage of customers who used reusable bags the prior week. This intervention was in place from April to May 2022 and indicated no significant change in behavior (i.e.,12% of 1,725 customers used reusable bags during the intervention phase). Because of this unsuccessful behavior-change intervention, an innovative intervention will be conducted in Fall of 2024, whereby two large signs will be placed in the same two grocery stores with the phrase “Plastic Bags Do This” and an image of the Great Pacific Garbage Patch. We hope to provoke feelings of guilt or cognitive dissonance which would consequently decrease the use of plastic bags. This would in turn lead the patrons to no longer feel guilt or cognitive dissonance.

Mentor(s): Scott Geller, Psychology, Virginia Tech

Nya Davis
Virginia Tech/Multimedia Journalism

Toxic Drinking Culture at Virginia Tech

This study examines the detrimental effects of binge drinking on the mental and physical well-being of students at Virginia Tech. The research question focuses on which influence or stressor contributes the most to the prevalence of excessive alcohol consumption. The purpose of this study is to shed light on the alarming rates of binge drinking and its impact on academic performance, safety, and overall student health here at Virginia Tech. Utilizing data from interviews, academic papers, and previous research, the study identifies the prominent role of factors such as athletic programs, prominent Greek systems, and the accessibility of bars and nightlife in increasing binge drinking tendencies among students. Moreover, it explores the coping mechanisms employed by students, such as drinking to alleviate stress, and the risks associated with such behaviors. The results highlight a significant correlation between alcohol consumption and risky behavior, including driving under the influence and sexual assault, as well as detrimental health effects such as liver damage and impaired cognitive function. Ultimately, this study underscores the urgent need for comprehensive strategies to address the binge drinking culture at Virginia Tech, emphasizing the importance of promoting healthier coping mechanisms and fostering a safer campus environment for all students.

Mentor(s): Katie Thomas,Communication, Virginia Tech

Alexander Davis
Virginia Tech/Chemical Engineering

Synthesis of Alkoxide-Supported First-Row Transition Metal Complexes

The goal of this project was to synthesize first-row transition metal complex pairs capable of selectively cleaving strong bonds, such as C-H bonds. The importance of this lies in the global demand for more sustainable production methods without the need for extreme reaction conditions or reliance on noble metal catalysts. We hypothesized that using weak field ligands, such as alkoxides, will allow for high spin electron configurations in first-row metal centers, increasing their reactivity. Using an alkoxide-based ligand, mononuclear vanadium and cobalt complexes have been identified. Testing for metal-metal cooperativity, we found that the vanadium/cobalt pair promotes the trimerization of alkynes under mild temperatures. The cobalt complex, when used individually, catalyzes the reaction of aryl acetylenes to yield a 1,2,4-substituted benzene isomer when initiated with excess alkynes, ultimately achieving full consumption of the reagent. However, when the cobalt and vanadium complexes are used together the reaction selectively produces the 1,3,5-substituted benzene isomer without the need for excess alkynes to initiate the reaction. We monitored reactions via 1H and 31P NMR and GC-MS to evaluate reaction selectivity and progression. Moreover, we also worked to crystallize reactive intermediates to identify the reaction mechanism and understand the metal-metal cooperativity.

Mentor(s): Diana Thornton, Chemistry, Virginia Tech

Maximo de Leon
Virginia Tech/Mathematics

Examining U.S. Treasury Yield Volatility Dynamics: A DCC-MIDAS Approach

This study presents a novel approach to analyzing the volatility and correlation dynamics across nine maturities of U.S. treasuries. By employing mixed data sampling techniques with low-frequency factors estimated from a large panel of economic indicators, we contribute a unique perspective to the existing literature. Our research introduces a factor-augmented approach to mixed data sampling-based volatility models, providing a more nuanced understanding of interest rate risk and the role of economic indicators in shaping uncertainty around monetary policy expectations.

Our methodology allows us to extract a small number of factors from a large panel of economic indicators using a factor estimation procedure. We then estimate a Dynamic Conditional Correlation model with Mixed Data Sampling, a sophisticated approach that allows for the decomposition of volatility into short- and long-run components. This enables us to examine the influence of economic factors on treasury yield volatility and correlations with a high degree of accuracy and reliability.

Our findings have significant implications for understanding and managing interest rate risk. Model specifications that incorporate realized volatility alongside factors associated with forward-looking variables enhance the explanatory power regarding yield dynamics. This insight can guide investors and policymakers in their decision-making processes. We also find that longer-dated treasuries demonstrate higher volatility persistence, indicating that these instruments are subject to more prolonged periods of fluctuation. Conversely, treasuries with shorter maturities show increased sensitivity to changes in economic indicators, indicating that the front end of the yield curve is more responsive to immediate shifts in economic and financial market conditions.

Mentor(s): Shamar Stewart, Agricultural and Applied Economics, Virginia Tech

Arthur Louie Deapera
Virginia Tech/Cognitive & Behavioral Neurscience

Heart-Rate Variability Correlates of Collaboration Among Neurodiverse Dyads

Our research aims to uncover how autistic adults engage in collaborative tasks and regulate physiological arousal compared to their neurotypical counterparts, to inform accommodations in workplaces requiring teamwork. Previous literature has indicated that higher baseline levels of heart-rate variability (HRV) reflect better autonomic regulation. This study investigates HRV between autistic and neurotypical populations during collaborative tasks in a virtual Minecraft setting. A total of 18 Participants (3 male and 15 female) ages 19-33 were involved in collaborative building tasks via zoom with a partner, with the first session of their baseline physiological activity recorded. Results suggested that collaborative behavior was associated with enhanced autonomic regulation, particularly in neurotypical dyads. These findings emphasize how social interactions, cognitive engagement, and physiological responses are linked with individual differences in the collaborative spaces, as evidenced in research regarding HRV and neurodiversity.

Mentor(s): Angela Scarpa-Friedman, Psychology, Virginia Tech
Megan Fok, Psychology, Autism Clinic & Center for Autism Research, Virginia Tech

Emelia Delaporte

Virginia Tech/Professional & Technical Writing; Multimedia Journalism

Developing evidence-based messages to strategically reduce human disturbance of shorebirds

The unique human usage of beach areas creates a vulnerability in shorebird species to disturbance, particularly by dogs. While limited signage and messaging exist, their success rates on changing the behaviors of dog walkers have room to grow. The aim of this study is to better understand what types of messages are best at promoting voluntary compliance to encouraging dog walkers to leash their dogs on the beach. The research investigates how framed messages impact a person's likelihood of complying with dog leashing regulations, influence the emotional response dog walkers have toward leashing regulations, and how their emotional responses impact their likelihood of compliance. The results of analyses conducted on the experiment will be produced via Statistical Package for Social Sciences (SPSS). The anticipated results of the experiment are expected to reflect significant differences in the probability of leashing by dog walkers near beach-nesting shorebirds, with deference to the message frame that they were exposed to.

Mentor(s): Ashley Dayer, CNRE, Fish and Wildlife, Virginia Tech
Sami Livingston, CNRE, Fish and Wildlife, Virginia Tech

Louhan Dembele

Virginia Tech/Public Health (College of Vet Med)

Understanding Black women's experiences with endometriosis diagnosis and treatment in Southwest Virginia

Current data indicates that around 10% of reproductive-age women in the United States suffer from endometriosis, a disease that impacts the reproductive organs, causing symptoms such as painful menstruation, pelvic pain, and potential infertility. However, because an official endometriosis diagnosis requires invasive surgery, this number might vastly underestimate the true prevalence of the condition. Black women in the United States are disproportionately impacted by adverse reproductive health outcomes due to a variety of factors including historic mistreatment within the medical system, racial bias and prejudice among health professionals surrounding pain assessment and treatment, and systematic racial bias and discrimination from societal norms and institutions with a history of racism. As with other areas of health, reproductive health is driven by socioeconomic factors including race, ethnicity, income, and location. This research project proposes to address the need of further understanding endometriosis among Black women by qualitatively eliciting Black women's psychosocial experiences when receiving an endometriosis diagnosis and subsequent treatment. Specifically, we propose to utilize focus groups and semi-structured interviews among n = 50 Black women living across Southwest Virginia (Blacksburg, Christiansburg, Radford, Roanoke, and Pulaski). To recruit participants, we will build on partnerships established in the Department of Population Health Sciences, including the Virginia Tech Center for Public Health Practice and Research, and ties with the NRV Department of Health. Additionally, we will also aim to broaden our inclusion criteria by eliciting participants with a suspected history of endometriosis (as opposed to a confirmed diagnosis via surgery) and/or treatment of endometriosis.

Mentor(s): Cori Ruktanonchai, Population Health Sciences (College of Vet Med), Virginia Tech

Louhan Dembele
Virginia Tech/Public Health (College of Vet Med)
Agatha Madej
Virginia Tech/Chemical Engineering
Megan Marken
Virginia Tech/Nanomedicine
Keagan McGovern
Virginia Tech/Biomedical Engineering
Bella Thelen
Virginia Tech/Biochemistry
Vy Tran
Virginia Tech/Systems Biology

Detecting schistosomiasis in urine using Raman spectroscopy with solar power in southern Malawi

Schistosoma haematobium (S. haematobium) belongs to a blood-fluke group known for causing schistosomiasis in humans and other mammals. Symptoms of schistosomiasis include fever, chills, joint pain, muscle aches, abdominal pain, and hematuria, and if left untreated, the infection can lead to bladder cancer. If caught early, however, short-term medication can be used to treat the infection. Schistosomiasis is endemic to many African countries, including Malawi. In Blantyre, Malawi, schistosomiasis prevalence is moderate, but likely underestimated due to a widespread lack of adequate testing. This illustrates the need for technology that is capable of detecting schistosomiasis in urine so that treatment can occur as soon as possible. Raman spectroscopy is a type of technology that creates a “fingerprint” of the sample, which can allow scientists to pinpoint an abnormality. Raman is inexpensive and portable, which is particularly helpful for developing countries with a higher prevalence of diseases, like schistosomiasis, that can be detected through urine samples. The problem, however, is that Raman spectroscopy requires Raman-trained personnel and access to electricity, both of which are scarce in Malawi. Since Malawi, on average, has sunlight for over half of daylight hours for the entire year, solar batteries can be used to power Raman machines and supporting equipment. The purpose of this project is therefore to demonstrate the efficacy and applicability of Raman spectroscopy in and around Blantyre, Malawi.

Mentor(s): John Robertson, Biomedical Engineering and Mechanics, Virginia Tech
Andre Muelenaer, Biomedical Engineering and Mechanics, Virginia Tech

Walter Dickey
Virginia Tech/Clinical Neuroscience

MATERIAL COMPARISON FOR SURGICAL SIMULATION MODELS

ce on lower fidelity models to refine sills. However no comprehensive psychomotor simulator exists for fundamental skill sets considered critical to competency in hand surgery. It is becoming more common to use a three dimensional printer to create models that have similar appearances to that of the bones and other anatomical structures. With the increase of the use of additive manufacturing technology, a more affordable and accessible way to produce in-house training models has been developed. There are many aspects that go into creation of these models with the first one being the selection of the material itself. Without examining the force of multiple different common additive manufacturing polymers it can be difficult to select one without countless trial and error. This study used a Stryker drill with wire collet and an Instron universal testing system (5967) to collect comparative force data using five different modeling materials compared to chicken bone. The data showed that the material with least average force difference from the bone models was polylactic acid (PLA).

Mentor(s): Christopher Arena, BMES, Virginia Tech

Sara Do
Virginia Tech/Biological Sciences

Role of Perm1 in Systemic Muscle Dysfunction of Heart Failure

Heart failure (HF) is a cardiac disease with systemic complications, affecting more than 64 million people. A severe symptom of HF is cardiac cachexia, defined as irreversible weight loss. The initial phase occurs as skeletal muscle wasting, exacerbating cardiac dysfunction. A vicious circle between the heart and skeletal muscle affects metabolism, emphasizing novel therapeutic strategies. The hypothesis is that gene delivery of Perm1 prevents the development of cardiac cachexia. Perm1 (striated muscle-specific regulator of energy metabolism) is downregulated in the human and mouse failing heart and loss of Perm1 in mice leads to reduced contractility and energy reserve. However, it is unknown whether and how Perm1 in skeletal muscle is involved in skeletal muscle wasting. We hypothesize that at the early stage of HF, systemic myopathy will occur simultaneously in heart and skeletal muscle when Perm1 is downregulated. As for results, data suggests that pressure overload via transverse aortic constriction will induce Perm1 downregulation in both organs. Moreover, Perm1 induces Musclin in C2C12 myotubes, indicative of Perm's role as a novel regulator of the cardioprotective myokine. Overall, this study suggests that Perm1 downregulation in skeletal muscle under hemodynamic stress contributes to energy dysfunction and reduced Musclin secretion, which might be an initial event of inter-organ crosstalk between heart and skeletal muscle in the progression of HF.

Mentor(s): Junco Warren, Department of Human Nutrition, Foods, and Exercise, Virginia Tech

Jessica Donald
Virginia Tech/Biochemistry
Ayla Lampros
Virginia Tech/Biochemistry
Alexander Dellinger
Virginia Tech/Biochemistry
Anna Thomas
Virginia Tech/Biochemistry
Ethan Davis
Virginia Tech/Biochemistry

Analyzing the Impact of Mutations in the JAR1 Active Site of Arabidopsis thaliana.

With disease being a primary threat to commercial farming, understanding how key residues affect mechanisms used to combat against disease and other extreme conditions is essential for the long-term health of grown species. JAR1, a producer of jasmonic acid, is essential for plant distress signaling and is used to trigger plant immune responses. In this work, active sites were probed to determine how a residue mutation in the active site would affect the function of JAR1. The resistance to mutation of ligand binding affinity in JAR1 was tested via molecular docking of the native substrate to a knockout substitution structure. The wild type of JAR1 had key residue SER-101 mutated to proline (PRO), with molecular docking demonstrated how substrate binding changed because of mutation. The mutation to PRO minimally lowered the binding affinity between the JAR1 and the native substrate. The mutated binding affinities were, on average, within a tenth of their control counterparts. Such differences are small enough that they would most likely be inconsequential. This indicates that the SER residue is not essential to ligand binding to JAR1. JAR1 having success despite alteration indicates that crops should grow in a usual manner even if there is a minor mutation, due to the tested mutation still allowing for JAR1 to properly function. Future research could explore other mutations with the intention of improving bonding, which would in turn make plants more responsive to disease.

Mentor(s): Anne Brown, University Libraries, Virginia Tech

Holly Durham
Virginia Tech/Human Development
Lauren Mazanek
Virginia Tech/Human Development
Devin Wang
Virginia Tech/Psychology
Ava Regehr
Virginia Tech/Human Development

Gesture and Learning in Young Children

The project examines patterns of speech and gesture in relation to preschooler's math learning and executive function (EF). Previous research has found that gesture-speech mismatch is related to older children's math learning. For instance, children who gesture a correct math procedure while explaining it incorrectly in speech tend to learn the new procedure more quickly than those who use matched or congruent speech-gestures. However, little is known about whether similar patterns are found in preschoolers. Since math learning and executive functioning are known to predict better later achievement in school, it is important to understand if preschool teachers might profitably pay attention to children's gestures as well as their language.

Methods: Child assessment to illicit gesture, speech, math, and EF performance. Preschoolers (3-5 years) will be assessed in a quiet room within their school and given four assessments to measure speech/gesture patterns, applied math problems, number line estimation, and EF. Team members were trained to reliably administer math and executive functioning tests and code conservation explanations. Assessments will be videotaped for later coding.

Summary of results: Anticipated results will be presented using mock data due to insufficient data collected at the time of the conference. Conducting anticipated results gives us practice in research analysis.

Mentor(s): Isabel Bradburn, Human Development and Family Science, Virginia Tech

Elayna Ealy
Virginia Tech/Environmental Conservation and Society

Chitosan as a Sustainable Approach to Improve Soybean Iron Deficiency Chlorosis

Iron Deficiency Chlorosis (IDC) is an agricultural problem affecting crops worldwide. Chitosan obtained from crustacean shells may improve plant iron (Fe) status. In this study we tested the ability of chitosan to improve IDC symptoms. Two soybean cultivars, DV-0197 (Fe-uptake efficient) and Dieckmann Green-Yellow (DGY; Fe-uptake inefficient), were grown for 14 days in hydroponics under controlled environmental conditions. The plants were divided into 4 treatments, with the nutrient solution containing 5 µM Fe (Fe-insufficient) or 30 µM Fe (Fe-sufficient) and supplemented with either 0 or 2% chitosan. Plant IDC score, fresh weight, and chlorophyll content were recorded on day 14. DV-0197 cultivated in Fe-sufficient or Fe-deficient conditions and supplemented with chitosan showed a trend for lower chlorosis symptoms and higher chlorophyll content, though this trend was not statistically significant. DV-0197 shoot and root weight were not different across treatments. Nonetheless, DV-0197 plants grown under Fe-deficiency and supplemented with chitosan had a higher survival rate, compared to the control of Fe-deficient plants. DGY plants grown under Fe-sufficient conditions showed significantly higher chlorophyll content and root and shoot fresh weight ($P<0.0001$) compared to plants grown in Fe-deficient conditions. Chitosan supplementation significantly lowered chlorosis symptoms on DGY plants grown in either Fe concentration ($P<0.05$), but results showed greater chlorophyll content only in plants grown in Fe-sufficient conditions ($P<0.0001$). Root fresh weight was significantly lower ($P<0.05$) in chitosan supplemented plants but only under Fe-sufficient conditions. Overall, results suggest that chitosan may improve survival and growth of soybeans, particularly of Fe-uptake in inefficient soybean varieties.

Mentor(s): Marta Lima, SPES, Virginia Tech

Zacarya Elbash
Virginia Tech/Neuroscience
Brooke O'neill
Virginia Tech/Neuroscience
Kaitlyn Williams
Virginia Tech/Neuroscience
Victoria Frank

Integrating lecture learning and Community-Engaged Learning (CEL) in Neuroscience of drug addiction.

Through the integration of Community-Engaged Learning (CEL) with the Neuroscience of Drug Addiction course, students are empowered to apply their knowledge of neuroscience in real-world contexts. This dynamic enables students to bridge challenging concepts with practical scenarios, fostering a deeper understanding and engagement with the course material. The projects for the course have been thoughtfully designed to allow students to facilitate effective communication of scientific concepts within the community. Students engage with various participants, including community partners, non-experts, and peers, to convey the relevance and implications of neuroscience in understanding drug addiction.

The projects encompass a diverse array of initiatives to engage students and the community in understanding and addressing the complexities of drug addiction through the lens of neuroscience. Projects involve (1) engaging adolescents in neuroscience-based substance use prevention education, (2) providing REVIVE! training for opioid overdose response (3) leading Recovery Ally Training within Virginia Tech's Recovery Community, (4) creating educational comics, (5) fostering safe spaces to discuss drug policy and the medical amnesty policy on campus, and (6) facilitating the Never Enough book club, which explores the author's path to sobriety. Together, these CEL projects exemplify a multifaceted approach to education, outreach, and engagement.

Teaching Assistants were central to the success of these community-engaged learning projects and played a vital role in facilitating interactions between students, the professor, community partners, and intended audiences. Serving as liaisons, they bridged communication gaps and ensured the effective execution of the projects, enriching the learning experience for all involved.

Mentor(s): Aparna Shah, School of Neuroscience, Virginia Tech

Micheal Erb
Virginia Tech/Nanomedicine

UNCOVERING THE MECHANISMS OF COLOR IN MINERAL-BASED COMMERCIAL PEARLESCENT AND METALLESCENT PIGMENTS

Pearlescent and metallescent pigments are used widely in various applications, including cosmetics, coatings and paints, electronics, plastics, and textiles, where a glossy iridescent appearance is desired. Compared to traditional dyes and pigments that produce color by selectively absorbing certain wavelengths of visible light, pearlescent and metallescent pigments produce a distinctive appearance through interference, plasmonic resonance, or diffraction mechanisms. These pigments oftentimes contain small particles made from minerals, such as micas, synthetic materials, or other structures with dimensions comparable to, or slightly larger than, the wavelength of visible light. The goal of this research is to integrate data obtained from several complementary characterization methods to establish the mechanisms of color in commercially sourced pigments, such as mica-based pearlescent pigments, calcium aluminum borosilicate pigments, and bismuth silicon-dioxide. These samples will be examined via scanning electron microscopy (SEM), energy-dispersive X ray spectroscopy (EDS), powder X-ray diffraction (XRD), and ultraviolet-visible spectroscopy (UV-Vis). Data on particle size, shape, atomic structure, and microstructure will be used to develop models describing the origin of color, and thus, the optical behavior of the pigments. With a better understanding of the intricacies in pigment morphology, a range of novel industrial applications will be proposed.

Mentor(s): Marc Michel, Geosciences/Nanoscience, Virginia Tech
Dr. Anita Trajkovska-Broach, Create. Solve. Innovate. LLC, Virginia Tech

Natalie Falls
Virginia Tech/Crop and Soil Environmental Science

Climate-Driven Shifts in Flowering Phenology of Native Culinary Flora of the Southern Appalachian Region

The Southern Appalachian Region has a diverse culture shaped by Native American and European influence with a strong connection to the geography and climate of the land. Culinary dishes common to this region serve as a source of identity, comfort, and connection to the land for Appalachian people. Many popular dishes utilize native flora which may become scarce or inhabitable to the region due to climate change. Relevant culinary flora were identified utilizing foraging guides and active social media foraging groups. Occurrence data for these plants were retrieved utilizing the Global Biodiversity Information Facility (GBIF) and filtered for presence in the Southern Appalachian Region. Photos of the flora were also accessed through GBIF and were classified on a scale of 0 to 4 based on phenological traits. We will use weather station data and multiple regression models to identify flowering trends for each plant species. We expect that our results will show a trend in warming weather and earlier flowering times and/or longer flowering duration for a significant number of species. These shifts may impact ecosystem biodiversity and important biotic relationships, such as pollination events and seed dispersal. These phenological shifts may also have cultural implications by affecting the use of these traditionally used species in the Southern Appalachian region.

Mentor(s): Jordan Metzgar, Biological Sciences, Virginia Tech

Emma Feinstone

Virginia Tech/Applied Discrete Mathematics

Obstacles of Learning Proof by Cases

Epistemological Obstacles (EOs) are defined as challenges that students face when exposed to concepts that contradict their pre-existing mathematical intuition. The objective of our poster is to address EOs that emerge during the lesson on proving by cases, rather than circumventing them.

At the study institution, students generally have experience with introductory proofs and must have taken discrete math. As such, they are expected to have experience with symbolic logic and operations on conditional statements, set theory and proofs on sets, and mathematical induction. Many upper-level students transfer from the local community college, which introduces a deficiency in the information on what students have and have not covered. The instructor intentionally structured the class to get students to 'play mathematician' by questioning arguments, positing hypotheses, and proving or disproving those hypotheses through routine think-pair-share cycles.

In particular, the instructor was aiming to introduce students to proof by cases, when to use cases, what cases to consider, and how to use the statement 'without loss of generality'. Through reflection on student reactions to lecture content, certain areas of the lesson could be improved. In particular, in-class examples can be chosen in a way that requires students to think more about how the constructs are used. Our intention with this poster is to get ideas on how we can improve the lesson and produce a lesson analysis manuscript from this material for a future journal submission.

Mentor(s): Rachel Arnold, Mathematics, Virginia Tech
Ahsan Chowdhury, Mathematics, George Mason University

Maddie Ferguson
Virginia Tech/Biochemistry

Iron-Sulfur Cluster Assembling Thioredoxin of Methanocaldococcus jannaschii

Thioredoxins (Trx) are small acidic proteins present in all domains of life, acting as a redox regulator of metabolism through protein cysteine disulfide bond reduction activity [6]. Methanocaldococcus jannaschii (Mj) is a chemolithoautotrophic, hyperthermophilic, strictly anaerobic, methane producing, and ancient type archaeon, that lives in deep sea hydrothermal vents. It contains a simpler thioredoxin system with two thioredoxins, MjTrx1 and MjTrx2. MjTrx2 is non canonical, reducing cysteine disulfide bonds poorly [6]. From both in vitro and in vivo analysis with a recombinant version produced in Escherichia coli we have concluded that MjTrx2 carries an oxygen sensitive [Fe4-S4] clusters. From further work that included structural analysis, we have hypothesized that MjTrx2 offers a potentially novel iron-sulfur cluster assembly system. To test this hypothesis, we are constructing an aconitase based hyperthermophilic Fe-S cluster transfer assay utilizing aconitase and isocitrate dehydrogenase of Mj [1].

Mentor(s): Biswarup Mukhopadhyay,Biochemistry, Virginia Tech

Isabella Filippone
Virginia Tech/Human Nutrition, Foods, and Exercise

Does mitochondrial hydrogen peroxide (H_2O_2) impact skeletal muscle adaptions to exercise?

Exercise is used as preventative medicine for numerous cardiometabolic diseases. These long-term, lasting benefits result from regular, short-term acute exercise that temporarily stresses the body by increasing energy demands beyond supply. Exercise stress triggers mitochondria to increase their metabolism and produce more energy. Reactive oxygen species (ROS) are immediately produced following exercise and in our lab, we have found the ROS producing enzyme NADPH-Oxidase 4 (NOX4) plays a critical role in mitochondrial metabolism post-acute exercise. NOX4 is localized to the mitochondria and produces ROS in the form of hydrogen peroxide (H_2O_2), a unique secondary messenger. The effects of mitochondrial H_2O_2 (m-H_2O_2) on cellular signaling remain largely unexplored. Thus, to investigate the impact of NOX4 and m-H_2O_2 on mitochondrial metabolism, my objective is to create a system where I can investigate the role of NOX4 and m-H_2O_2 in vitro. To do this, I cultured C2C12 skeletal muscle cells, and transfected them with Nox4 (increased H_2O_2) and/ or mitochondrial-targeted catalase (Cat; an efficient H_2O_2 scavenger), using green florescence protein as a control. To mimic exercise, I treated C2C12 cells with hypoxia or low glucose and measured gene expression via qPCR. My initial findings confirmed my system worked, demonstrating increased expression of Nox4 or Cat, and known stress responsive genes. While much more is needed to confirm the mechanistic role of NOX4 and mitochondrial H_2O_2, I have created an in vitro system to uncover mechanistic targets of NOX4 and m-H_2O_2.

Mentor(s): Siobhan Craige, Human Nutrition, Foods, and Exercise, Virginia Tech

Logan Flanagan
Virginia Tech/Water: Resources, Policy, and Management

Variation in Hydrologic Signatures in the Southern Appalachian Mountains and Continental United States

Hydrologic signatures are defined as quantitative metrics that describe streamflow statistics and dynamics. They help assess habitat suitability, hydrologic alteration, and calibrate hydrologic models. Signatures exhibit variation driven by climatic and physiographic variables, with climatic variables being more significant. Most studies investigating controls on hydrologic signatures are performed at the continental scale. In this study, we investigate how hydrologic signatures at the regional scale vary in the Southern Appalachian Mountains compared to the continental United States utilizing the CAMELs dataset. We calculated mean annual discharge, mean winter discharge, mean summer discharge, high flow (90th percentile), low flow (10th percentile) BFI, runoff ratio, and flashiness using the Richards-Baker Index and compared the range of values in the southern Appalachians to the continental US. Preliminary results suggest that while there is typically larger variation in hydrologic signatures across the continental United States, some signatures at the regional scale display a range of variation similar to the continental scale. Previous work showed that, across the southern Appalachian mountains, physical characteristics describing critical zone structure are significant drivers of baseflow, high, and low flow signatures. Based on these results, we propose that it is possible to determine which physiographic variables significantly control hydrologic signatures when studying physiographic regions with less climate variability but significant variability in signatures.

Mentor(s): J.P. Gannon, Forest Resources and Environmental Conservation, Virginia Tech
Lindsey Finks, Forest Resources and Environmental Conservation College of Natural Resources and Environment,Virginia Tech

Madison Fleming
Virginia Tech/Psychology
Dylan Hughson
Virginia Tech/Psychology
Rebecca Cuthbertson
Virginia Tech

Maternal Parenting Styles and Emotional Development in Middle Childhood

Research supports the notion that parents' psychological control and support impact children's future emotional functioning ability (Wang et al., 2007). Similarly, parents' behavior during development affects the child's emotional reactivity (DePasquale &Gunnar, 2020). We studied how intrusive and positive maternal parenting styles, affects children at age six with different facets of emotional development, effects in areas like cognitive flexibility, effortful control, and emotional control. Additionally, we assessed how child factors correlated as well. Maternal parenting behaviors were measured during an interactive puzzle task at age 6. Cognitive flexibility at age 6 was measured in the Dimensional Change Card Sorting Task. Effortful control was maternally reported via the CBQ, and emotional control was maternally reported via the BRIEF questionnaire.

Bivariate correlational analyses were conducted, assessing whether two variables covary linearly, or if a significant statistical association exists between the two variables of interest. Our results showed that different parent styles were significantly related to child effortful control, child cognitive flexibility, and child emotional control in six-year-olds. Specifically, more maternal intrusiveness related to less child effortful control ($R = -.145$, $p = .026$), and more maternal positivity related to greater cognitive flexibility ($R = .149$, $p = .022$). Additionally, Greater child effortful control was associated with higher emotional control ($R = .297$, $p < .001$) These results potentially highlight the importance of parenting styles on a child's ability to self-regulate and develop cognitive skills during middle childhood.

Mentor(s): Mohamed Zerrouk, Psychology, Virginia Tech
Martha Ann Bell, Psychology, Virginia Tech

Kristen Folk
Virginia Tech/Animal and Poultry Sciences

Impact of heat stress on mammary insulin receptor distribution in lactating dairy cows

Heat stress is a global issue that compromises dairy cattle welfare, reduces milk production, and decreases profitability. Heat-stressed cows drop feed intake, accounting for 50% of milk production loss. The working hypothesis of the other 50% loss is heat stress (HS) altering nutrient metabolism and allocation by diverting nutrients away from milk synthesis in the mammary gland. Insulin is a key hormone implicated in this metabolic response during HS. Initially, the objective of this work was to quantify mammary insulin receptor abundance in lactating dairy cows (n = 8) with exposure to HS for 4 d compared to non-heat stressed pair-fed cows (n = 8). Archived formalin-fixed paraffin embedded (FFPE) mammary samples from each cow were subjected to immunohistochemical staining for insulin receptor (INSR). Initial results showed no INSR staining, questioning the utility of the primary antibody. Therefore, the objective shifted to an INSR antibody validation experiment. Microscope slides from archived FFPE bovine tissues known to be positive control (skeletal muscle, cardiac muscle, adipose, kidney) and negative control (spinal cord, lung) tissues for INSR were prepared. Four antibodies and five antigen retrieval buffer conditions were tested in all combinations. Insulin Receptor Rabbit pAB (Abclonal) showed subjective visual evidence of INSR staining however signaling could not be objectively identified by wavelength differentiation, therefore it could not be validated. The other three antibodies did not identify INSR in any of the tested tissues. Additional testing of other antibodies is indicated for validation before continuing work in bovine INSR detection in mammary tissue.

Mentor(s): Kristy Daniels, Department of Dairy Science, Virginia Tech

Lia Fontanella
Virginia Tech/Biological Sciences

Metabolic scaling in salamanders with biological size

Studying how metabolism, body mass, and size correlate offers valuable insights into organismal physiology and evolutionary history. Kleiber's law, which states that an animal's metabolic rate scales to the ¾ power of its mass, applies widely across animal life. This observation led to the metabolic theory of ecology, which broadly seeks to explain biological scaling laws using the optimization of an organism's nutrient distribution networks. Salamanders, however, display surprising variability in their relationship between metabolic rate and body mass and size and frequently violate Kleiber's law. The reasons for this incredible diversity is currently unknown. One possible explanation is the extremely large and variable genome sizes of salamanders. Large genome size is associated with large cell size. Thus, salamanders have fewer cells compared to other organisms of comparable size. This unique trait has earned salamanders the nickname "macroscopic microorganisms" and may have implications for explaining why they express diversity in their metabolic rates. Here, we use the Biological size index-- calculated by dividing body mass by the square of genome size--to try to explain metabolic scaling variation in salamanders. I compiled data and linked data from various sources, including genome sizes, metabolic rates, and body sizes of multiple salamander species. Utilizing a salamander phylogenetic tree, I investigate the relationship between metabolic rate and body mass, alongside metabolic rate and biological size; testing whether ""biological size" is a better predictor of metabolic rate compared to body size.

Mentor(s): Josef Uyeda, Biological Sciences, Virginia Tech

Savanah Fox
Virginia Tech/Microbiology

Eunice Akinade
Virginia Tech/Clinical Neuroscience

Leah van Gelder
Virginia Tech/Biomedical Engineering

Ayah Ali
Virginia Tech/General Engineering

Bethany Crittenden
Virginia Tech/Materials Science and Engineering

Pheobe Plank
Virginia Tech/Biomedical Engineering

Victoria Tabacchi
Virginia Tech/Mechanical Engineering

Irmak (River) Ocel
Virginia Tech/Public Health

Investigating Additive Manufacturing Challenges in Low-Resource Settings through the Biodesign Needs-Finding Process

Preventative and reparative maintenance of medical equipment remains challenging in low resource settings due to complex supply-chain challenges. Additive manufacturing can expand innovation infrastructure and enable local production of critical medical supplies, such as spare parts and consumables. However, sustainable implementation of additive manufacturing requires a systems-thinking approach with interdisciplinary collaboration, including consideration of recycling locally available plastics for reuse. The overarching goal of our project is to support local manufacturing of critical medical device components in low resource settings through recycling of plastics for additive manufacturing. During Spring 2024, our project purpose was to systematically engage with relevant stakeholders in Malawi, Nigeria, and the United States to identify high-priority opportunities for improving local additive manufacturing. We leveraged the Stanford Biodesign Process as our methodological framework, beginning with the needs-finding and needs-screening process. Throughout the Biodesign process implemented by the research team, preliminary research on plastic recycling was conducted, relevant stakeholders were identified, and leaders and members of global makerspaces were interviewed. The key insights were subsequently aggregated and analyzed using thematic analysis and conclusions were drawn regarding the specific challenges that warranted the most feasible and impactful solution. While applying the bio-design needs-finding process, the team determined that a critical gap in 3D printing capabilities in low-resource settings can be addressed through optimizing the recycling processes of consumer plastic waste into more easily accessible filament for additive manufacturing. Our future work includes continuing the Biodesign process through concept generation and screening in collaboration with our local and global partners.

Mentor(s): Ashley Taylor, Department of Biomedical Engineering and Mechanics, Virginia Tech
Andy Muelenaer Jr, Department of Biomedical Engineering and Mechanics, Virginia Tech
Penelope Muelenar, Department of Biomedical Engineering and Mechanics, Virginia Tech

Sarah Fuccello
Virginia Tech/Biochemistry
Myra Kariuki Kariuki
Virginia Tech/Biochemistry
Michael Reed
Virginia Tech/Biochemistry
Weizhi Lin
Virginia Tech/Biochemistry

Comparing Beta D-Fructopyranose and Glucose Binding to Glucokinase

Glucokinase plays an important role in cellular respiration and insulin release in the pancreas. Glucokinase catalyzes the transfer of a phosphate group from adenosine triphosphate (ATP) to glucose, which is the first step of glycolysis and essential for cellular respiration. There are many molecules similar to glucose in composition and structure. Beta D-fructopyranose is particularly interesting as fructose and glucose share the same molecular formula and have similar structures, resulting in the potential to have very similar binding affinity and products when bound to glucokinase. Molecular docking was used to determine the binding affinity of fructose to glucokinase. When docked into glucokinase, fructose oriented in the binding pocket with a pose that had a binding affinity of -5.9 kcal/mol, which was very similar to the binding affinity of glucose at -5.8 kcal/mol. The affinities for all the poses were very similar to those of glucose as was orientation in the binding pocket. These results indicate that fructose interacts with glucokinase similarly to glucose and may play a related role in glycolysis and the release of insulin from pancreatic cells. Further studies could look at interactions with other sugar molecules such as sucrose and determine if such substances have a similar affinity.

Mentor(s): Anne Brown, University Libraries, Virginia Tech

Caroline Gardner
Virginia Tech/Human Nutrition, Foods, and Exercise

Nonsense Mutation Causing Autosomal Recessive Hypercholesterolemia

Autosomal recessive hypercholesterolemia (ARH) is a genetic disorder caused by mutations in LDLRAP1, a gene encoding a protein that allows LDL to be taken up and degraded in the liver. In silico tools were used to examine the rs121908325 variant linked to ARH. This variant affects the coding region of LDLRAP1, resulting in a glutamine amino acid being changed into a stop codon, truncating the protein at amino acid 136. Phylogenetic analysis of ten different animal species demonstrated that glutamine 136 is 100% conserved in the LDLRAP1 protein from the human protein to flies and frogs. An NCBI Conserved Domain Search for LDLRAP1 indicates that the variant truncates the protein within a peptide binding domain, a phosphoinositol binding domain, as well as a domain that specifies the Pleckstrin protein superfamily of signaling proteins. IntFold 3D rendering of wild type and variant proteins shows that the variant protein has a significant alteration 3D structure, based on the loss of hundreds of amino acids. Further in silico analysis using amino acid interaction software shows that the variant protein was missing its tyrosine binding pocket. The variant is rare, with none of the 70 genomes surveyed for rs121908325 identified in a Virginia Tech student genome dataset. These in silico studies demonstrate that the nonsense mutation at position serine 135 would impact specific domains of LDLRAP1, ultimately inhibiting the protein's ability to perform its function of removing LDL from circulation, leading to potential cardiovascular health complications.

Mentor(s): Deborah Good, Human Nutrition, Foods, and Exercise, Virginia Tech

Ariana Garrastegui Segarra
Virginia Tech/Cognitive and Behavioral Neuroscience
Hector Montemayor
Virginia Tech/Computational and Systems Neuroscience
Brooke Steiner
Virginia Tech/Experimental Neuroscience
Alex Haynes
Virginia Tech/Experimental Neuroscience

The Effects of an Acidic Pollutant on the Nervous System of C. elegans

Climate change has resulted in changes to the incidence and intensity of heat waves. These have been linked to neurological and neurodegenerative pathologies, including Alzheimer's, Parkinson's, and Motor Neuron Diseases. While there does seem to be a pattern between global warming and the prevalence of neurodegenerative diseases in literature reports, the direct link between them is yet to be established. We hypothesize that long-term exposure to varied levels of acidic pH in water reduces associative learning in C. elegans. We test this by exposing C. elegans to three pH levels (7, 4 and 3) for 7 consecutive days. We use an associative learning paradigm to test the learning ability and feeding behavior of the test group against the control. We anticipate as the acidity increases, the associative learning in C. elegans will decrease. The results of the experiment would provide meaningful applications in understanding environmental impacts on the nervous system and encourage further inquisition toward strategies to combat resultant effects. The preliminary results show that C. elegans in the pH 3 condition failed to demonstrate associative learning, whereas worms in pH 7 and 5 conditions did demonstrate this.

Mentor(s): Jennifer Rainville, School of Neuroscience, Virginia Tech

Brady Gates
Virginia Tech/Wildlife Conservation

Climate change's effect on the availability of medicinal plant species in the southern Appalachian Mountains

The southern Appalachian Mountains hold a wide diversity of native medicinal flora that have been traditionally harvested for centuries. Many of these species are threatened by growing collecting rates from foragers and pharmaceutical companies; this pressure combined with climate change could affect the survival of these traditionally used species.This project uses bioinformatic softwares to analyze presence data from the GBIF database and climatic information from Worldclim to create Ecological Niche Models (ENMs) for a number of target species of southern Appalachian medicinal flora. A custom R-script was used to download presence data and filter it to remove erroneous entries, habitat projections were created by processing the occurrence and climate data using MaxENT, implemented in R*, and visualized in QGIS. We observe predicted future habitat shifting to higher latitudes and upward in elevation to cooler environments in correlation to the severity of each climate change model. Losses and shifts of suitable habitat as a consequence, include the loss of genetic diversity, new management concerns, and the need for sustainable harvest techniques. These threats could cause local foragers to lose access to traditional medicinal plants as the climate warms. We will combat this by sharing our recommendations with conservation agencies to preserve these species and their traditional uses.

Mentor(s): Jordan Metzgar, Biological Sciences, Virginia Tech

Vasundhara Gatne
Virginia Tech/Computer Science

Predicting Exoplanet Occurrence Using Association Analysis

Over the past few decades, there has been a remarkable surge in exoplanet discoveries, leading to substantial availability of exoplanet data (currently ~5400 exoplanets found, with many thousands more anticipated to be discovered with present and future observatories). This calls for a need to efficiently and thoroughly process these complex datasets in order to identify significant trends and gain insights into the characteristics of exoplanets. In this presentation, we demonstrate the advantage of leveraging machine learning to understand exoplanet occurrence and formation based on patterns observed within astronomical data. By employing a technique called association analysis, we examined the most frequently co-occurring patterns of planet subtypes in several thousand exoplanetary systems. For example, one prominent planet subtype is classified as a "Warm Mini-Neptune," defined by a radius between 1.7 and 3.9 times that of Earth and an equilibrium temperature ranging from 400 to 1000 K. We take account of various planetary characteristics and spectral properties while subsetting the dataset and constructing the data structures in our algorithmic approaches. We then explore the ‘rules’ derived from our algorithm to discover and understand the significant associations found in the data. For instance, a rule might show that a planetary system with a spectral type of "A" and containing a "Hot Terrestrial" planetary subtype tends to also include a "Warm Mini-Neptune." We identify the most ‘interesting’ rules based on their potential to inform pressing exoplanetary science questions (such as planet formation and the search for potentially habitable conditions), and further project predictions for specific systems that may harbor undiscovered planets. Our results offer compelling insights and implications into aspects of planet formation, the composition and architecture of planetary systems, the identification of potential habitable candidates, and the characterization of exoplanets. Overall, this project establishes a valuable and adaptable framework for future research, with its predictive power expected to grow along with the continually increasing abundance of exoplanet data.

Mentor(s): Michael Wong, Carnegie Science Earth & Planets Laboratory, Virginia Tech
Dr. Anirudh Prabhu, Carnegie Science Earth & Planets Laboratory, Virginia Tech

Jeehyun Ghang
Virginia Tech/Biological Sciences

Prevalence of tick-borne pathogens in field-collected ticks

Globalization, international movement, habitat alteration, and changing climates can affect the geographical range and size of populations of ticks and the disease-causing pathogens they can carry. Tick-borne agents are crucial to understand as they represent substantial public and animal health threats, with consequences for humans and animals as tick vectors shift. I will focus on two key disease vector species in Virginia, Amblyomma americanum and Ixodes scapularis, and the bacterial and viral pathogens they may transmit: Heartland, Bourbon, and Powassan viruses, as well as Borrelia spp., Ehrlichia spp., and Anaplasma phagocytophilum. Through dual extraction from field-collected ticks, DNA/RNA will be extracted for gene-targeted PCR amplification methods to assess the pathogen infection rates in each tick species. The results will show the trend between county regions and the prevalence of specific pathogens and act as an early warning system for spreading known diseases in new areas.

Mentor(s): Gillian Eastwood, Entomology, Virginia Tech

Xavier Gitre

Advanced Studies Blacksburg High School Student

The Impact of Environmental Methylmercury Exposure on the Feeding Rates of Invertivorous Passerines

The impact of environmental exposure to methylmercury (henceforth MeHg), a potent neurotoxin, on the feeding rates of resident invertebrate-eating songbirds in winter was examined along a stretch of the South River, a waterway contaminated with mercury, north of Waynesboro, Virginia. Research into the neurobiological effects of MeHg exposure in birds has established a variety of potential impediments to avian foraging, such as behavioral alterations that result in the avoidance of high-energy behaviors and impeded coordination. It was hypothesized that invertivorous passerines with high environmental MeHg exposure would exhibit decreased feeding rates when compared to those with little or no exposure. This was tested by the measurement of feeding rates of resident species with the highest mean blood MeHg concentrations at contaminated sites. A small but statistically significant difference was observed between feeding rates of target species at contaminated and reference sites, a difference that was accentuated in Carolina Wrens, the species with the highest known blood MeHg concentrations at the study sites, and absent in Carolina Chickadees, a species with lower blood MeHg concentrations. However, it should be noted that the sample sizes were only large enough for preliminary findings. I plan to collect more data through a variety of methods before definitively establishing an inverse correlation between MeHg exposure and feeding efficiency. Regardless, the preliminary results of the study do support the hypothesis that invertivorous passerines with high environmental MeHg exposure exhibit decreased feeding rates when compared to those not exposed.

Mentor(s): Katharine Davis, Blacksburg High School Science Department

Kristen Glaser

Virginia Tech/Biological Sciences on the Biomedical Track

Understanding How Pubertal Development Influences Neural Cognitive Control and Neural Reward Processing in Adolescents

Pubertal onset during adolescence is a vulnerable period characterized by social, physical, and cognitive changes. Hormonal changes during this time are associated with brain development in cognitive and affective regions (Ladouceur et al.,2012; Larsen & Luna, 2018). During adolescence, differences in the development of neural cognitive control and reward processing in the brain are related to risk for negative mental health outcomes. It is important to understand how puberty affects brain development in addition to typical age related changes. This study examined how pubertal stage is associated with neural cognitive control and neural reward processing during risky decision making. The current study included 167 adolescents ages 13-14 (53% male). Participants completed tasks related to cognitive control and risk processing during a functional magnetic resonance imaging (fMRI) scan. Puberty was measured using the Pubertal Development Scale (PDS). The two tasks used were the Multi Source Interference Task (MSIT) to measure cognitive control and an Economic Lottery Choice task to measure risk related reward processing.The results indicated that later pubertal stage was associated with higher frontoparietal activation during cognitive control ($r = .17$, $p = 0.04$). Additionally, we found that later pubertal stage was associated with less activation in the dorsal anterior cingulate cortex ($r = -.17$, $p = 0.04$) during risk-related decision making. Findings suggest that pubertal maturation is significantly associated with neural activation patterns related to higher risk-taking behaviors. Future research should examine how pubertal development is associated with longitudinal brain changes to better understand how it affects mental health outcomes.

Mentor(s): Jungmeen Kim-Spoon, Pyschology, Virginia Tech

Julia Gregory
Virginia Tech/Microbiology

Characterizing X1 in SARS-CoV-2 infection

SARS-CoV-2 is a positive sense ssRNA virus that acts by binding to the ACE2 receptor to infect cells. Once inside, the RNA is sensed and bound to RIG-I or MAVS, antiviral signaling pathways activating NFκB and IRF signaling to induce an innate immune response. NLRX1, a pattern recognition receptor in the NLR family, inhibits MAVS, NFκB, and IRF signaling, decreasing the immune response. We hypothesize that NLRX1 has a significant role in the immune response to SARS-CoV-2 infection. Previous in vitro work indicates NLRX1 plays an anti-inflammatory role in viral clearance. To better understand underlying mechanisms, Calu3, lung epithelial cells, were transduced using lentivirus to overexpress (OE) and knockdown (KD) NLRX1 expression. Post challenge with SARS-CoV-2 (MOI 0.05, 0.1), NLRX1 OE cells have significantly decreased viral titer compared to controls with KD cells showing no difference. Further understanding this phenotype, OE and KD cells were challenged with various SARS-CoV-2 NSP2, nucleocapsid, and envelope proteins. Cytokine response was measured by rt-qPCR to quantify RNA expression of IL-6, IFNβ, and IRF3. Overall, expression of proinflammatory signals were increased in KD cells and decreased in OE cells compared to controls. This suggests that NLRX1 acts to inhibit the expression of proinflammatory pathways during the SARS-CoV-2 response. Further investigation into the difference of cytokine expression caused by the presence or absence of NLRX1 could lead to a possible drug target.

Mentor(s): Irving Allen, Biomedical Sciences and Pathobiology, Virginia Tech

Maisoon Haddadin

Virginia Tech/Wildlife Conservation

Antibiotic Resistance Profiles of Escherichia coli isolated from Elephants in the Chobe Region of Botswana

Increased exposure to antibiotics and antibiotic residues through human and livestock use has amplified spread of antibiotic resistance. Bacteria resistant to antibiotics can move across the landscape through many forms of transportation including water and animals. Escherichia coli is a bacteria found in the intestines of animals and is considered an important indicator for declines in food, water, or environmental quality. In this study, antibiotic resistance (ABR) of E. coli from African Elephants (Loxodonta africana) of the Chobe region of Botswana were tested.

Methods: E.coli were isolated from elephant feces in Kasane, Botswana and shipped to VT. At VT, PCR was used to amplify the phoA gene, confirming identification. ABR was determined using the Kirby-Bauer Disc diffusion method to 12 antibiotics: tetracycline, doxycycline, sulfamethoxazole, streptomycin, ampicillin, chloramphenicol, ciprofloxacin, gentamicin, cefotaxime, amoxicillin-clavulanic acid, and azithromycin.

Results: E.coli was isolated from 100% of 190 elephant fecal samples. ABR was uncommon in elephant E.coli isolates screened (3/65). E.coli isolates were resistant to sulfamethoxazole (1) and cefotaxime (2).

Significance: Elephants are the largest herbivore in the Chobe region, moving through human and protected lands. These findings indicate that elephants are impacted by environmental pollution and may serve to amplify or spread resistance within protected environments. Conservation methods should consider how these animals may be affected by human uses of antibiotics.

Acknowledgement: Funding for this work was provided by the National Science Foundation under award number 200971

Mentor(s): Monica Ponder, Food Science and Technology, Virginia Tech
Kathleen Alexander, Fish and Wildlife Conservation, Virginia Tech

Neva Hafeez
Virginia Tech/Biological Sciences & Clinical Neuroscience
Lily Smith
Virginia Tech/Clinical Neuroscience
Adrienne Harvey
Virginia Tech/Clinical Neuroscience

Never Enough Book Club - A Community Engagement Project

As a part of our course, Neuroscience of Drug Addiction, which incorporates service learning, we endeavored to set up a book club to engage periodically with non-neuroscience majors to discuss the book Never Enough by Dr. Judith Grisel, a prominent neuroscientist and educator. However, due to challenges with engaging community members, we revised our plan and decided to meet with the author herself and hold an informed discussion on the book.. The discussion itself is posted as a "mini-blog" along with our reflections. Our target audience remains the same, those who are not well-versed in the field of neuroscience, and those who want to know more about the underlying mechanisms of drug addiction. The personal aspect of the book is also something that is valuable to the project, as Dr. Grisel describes her own experience with addiction, giving insight to what it may be like for a loved one who is suffering from it. The significance of this project lies in the message of the book, which encourages people to be more informed on topics such as drug addiction and neuroscience, as well as promoting a supportive environment for those who struggle with addiction. Overall, this project aimed to increase community awareness of addiction; it is an important time to be educated about the topics in the book as the drug issues in America are worse than ever, with new, more dangerous drugs becoming more accessible.

Mentor(s): Aparna Shah, School of Neuroscience, Virginia Tech
Brooke O'Neill, School of Neuroscience, Virginia Tech

John Hajdo
Virginia Tech/German

Phonological Stability of /r/ in Namdeutsch: A Corpus-Based Study

The phoneme /r/ displays a huge amount of variation in European languages, appearing in at least a dozen distinct forms. This is particularly true in German, where almost all of those forms can be found and are known to change quickly and unpredictably. One factor that typically spurs such sound change is language contact, especially as a result of colonization, wherein one language is introduced to an entirely new linguistic environment. For example, the German colonization of Namibia in the late 19th century created a dialect, Namdeutsch, that still exists among the many other languages of the country, today spoken by about 1% of the population. However, the little research that has been done on Namdeutsch has shown that it has retained much of its Standard, Northern German phonology, but that does not include the notoriously mutable /r/. The aim of this paper is to determine how, if at all, /r/ has changed within Namdeutsch based on the Deutsch in Namibia corpus. We transcribed 700 instances of /r/ as spoken in audio recordings by 35 speakers of 4 generations and 4 regions, with a mix of formal and informal speech. In analyzing the frequency of every /r/ documented, we found no significant trends of sound change across generations, regions, formalities, or sexes. Rather, we found that the Namdeutsch /r/ remains consistent with that of Standard German. This phonological stability is most likely a result of the privileged sociolinguistic status of German in Namibia and its speakers' relatively insular community.

Mentor(s): Katie Carmichael, English, Virginia Tech

Caleigh Hampton
Virginia Tech/Human Development

"I would like a diet Sprite" /ay/ monophthongization in Southwest Virginia

Appalachia is a unique region that has been considered linguistically distinct from both Mainstream US English and Southern American English (SAE) (Wolfram & Christian, 1976, Reed, 2016). One stereotypical feature shared by SAE and Appalachian English (AE) is /ay/ monophthongization. Monophthongization occurs when a dipthong simplifies into a monophthong through the ungliding of the vowel (in the case of /ay/ monophthongization, this may make a word like 'ride' sound like 'rahd'). Within SAE, /ay/ monophthongization only occurs in pre-voiced ('ride') and open-syllable contexts ('rye'), while in AE it can occur across all contexts, including pre-voiceless environments like 'right'. In this study, I examine /ay/ monophthongization in Southwest Virginia (SWVA), examining rates of monophthongization by both phonetic context and speaker gender. Linguistically, gender groups typically pattern differently, meaning speaker gender can play a significant role in predicting monophthongization (Labov, 2001, Thomas, 2013). Using a corpus of 14 speakers (7 M; 7 F) of AE from SWVA, I generated a mixed effects logistic regression model of monophthongization. Results show that the chances of monophthongization is lower in voiced and voiceless contexts ('ride', 'right') compared to open syllables ('rye'). While gender did not have a significant effect on monophthongization, it was approaching significance at $p<0.07$, with men demonstrating higher rates of monophthongization than women, particularly in voiced and voiceless contexts ('ride', 'right'). This differs from prior work, which finds similar rates for voiced ("ride") and open syllable contexts ("rye"), which suggests SWVA is a ripe area for further examination for /ay/ monophthongization.

Mentor(s): Katie Carmichael, English, Virginia Tech

Sydney Haney
Virginia Tech/Wildlife Conservation

Virginia's Endangered, Threatened, and Endemic Species

Virginia is home to over 70 federally threatened or endangered species, and over 140 endemic species. Many more have been proposed as threatened or endangered, whether recommended for listing by scientists or formally petitioned. The goal of this project was to create unrestricted information accessible beyond conservation professionals without further endangering target species through exhibitions, printed, and digital products. I researched regional species, then worked with managers to locate endangered, threatened, and endemic species to then create high-quality, charismatic images with associated conservation stories accessible to the public and scientists. Care was taken to not further species risk by collaborating with state biologists and other professionals during field trips and by removing any sensitive location information. Photographs and stories of twelve species and conservation efforts have been curated so far. In some cases, these photographs are the highest quality images of the species available. This project also assessed barriers to conservation efforts that often result from inaccessibility of information. Collaborators emphasized the importance of sharing a compelling story of these species with the public and other scientists. Success of petitions for listing is heavily influenced by available information; collaborators have cited a lack of quality images available to scientists and lack of public and scientific awareness as barriers to conservation efforts. Because many of these species are on private land, collaborators emphasized the need for public input, information sharing and a compelling narrative as a way to continue to facilitate learning and sharing with the public towards improved conservation efforts.

Mentor(s): Sally Entrekin, Entomology, Virginia Tech

William Hanrahan
Virginia Tech/Biochemistry

Effects of Flavonoids on Non-Transcriptional Circadian Rhythm Pathways of Arabidopsis thaliana

The circadian rhythm in plants is a crucial regulator of numerous metabolic pathways and processes, such as photosynthesis, flowering, carbon metabolism, and leaf decay. The biological clock in most cells generally involves transcription-translation feedback loops (TTFL), but another mechanism involving non-transcriptional oscillators (NTO) exists. These NTOs can occur through oscillating peroxide levels. Investigating the role of flavonoids in modulating the plant's circadian rhythm could open new areas of research about the circadian rhythm. To investigate the interactions of flavonoids, molecular modeling was utilized to examine the binding energies and interacting residues of Arabidopsis thaliana peroxiredoxin A (AtPRXA). A multiple sequence alignment and structural overlay were created to compare structures between AtPRXA and human peroxiredoxin 5 (HsPRDX5). Molecular docking demonstrated that quercetin and rutin bind to the AtPRXA binding site with -21.6 and -28.5 kcal/mol respectively. It was also found that quercetin interacted with Cys-119 in the AtPRXA, a key active residue. Comparing AtPRXA to HsPRDX5, there is only 16% conservation of residues, yet they have near-identical secondary and tertiary structures. These results support the idea that flavonoids play a role in A. thaliana's circadian rhythm through NTOs and that these findings may translate to NTO mechanisms in human cells. Future directions of this research are investigating the integration of the chloroplast's NTOs with the plant cell's TTFLs to learn how each role plays in the circadian rhythm of A. thaliana and to investigate the homologous pathways in human cells to better understand how these NTO mechanisms impact humans.

Mentor(s): Anne Brown, University Libraries, Virginia Tech

Michael Harrigan

Virginia Tech/Cognitive and Behavioral Neuroscience

Intervening to Increase Expressions of Gratitude between Pedestrians and Vehicle Drivers: Impact of a behavioral prompt

Approximately 35,000 individuals – including 6,000 pedestrians – die in traffic collisions annually (NHTSA, 2020). Many such collisions are influenced by irrational decision-making, which can result from psychological distress (Kassam, 2009). Reducing such distress may decrease the occurrence of vehicle crashes. Expressions of interpersonal gratitude has been shown to reduce psychological distress (Bono, 2018).

Our field study has been investigating the impact of prompting pedestrians to express gratitude to drivers of vehicles who yield at crosswalks. We strategically place a sign reading, "Please Thank Drivers with a WAVE" at one crosswalk entrance. The sign's location is alternated weekly between the entrances of two heavily-used marked crosswalks on our campus.

Trained researchers systematically observe pedestrians from both ends of the crosswalk, noting whenever a pedestrian expresses gratitude to the driver of the stopped vehicle. This method systematically compares prompted and unprompted pedestrians within one-hour observation sessions. By comparing the behavior of pedestrians who pass by the sign with those who do not pass the sign under otherwise equivalent conditions, we can demonstrate functional control of the behavioral prompt.

Over five consecutive weeks, 11.8% of 6,338 prompted pedestrians and 10.8% of 5,851 control pedestrians waved signs of gratitude. While statistically and socially significant, the result's effect size is too small to constitute external significance. Future research may aim to increase visibility of the sign, striking a stronger balance between social and external significance.

Mentor(s): E. Scott Geller, Psychology, Virginia Tech

Michael Harrigan
Virginia Tech/Computer Science
Jared Bluesteen
Virginia Tech/Mechanical Engineering

SMS Fingerprinting: Predicting Personality Traits and Mental Illness from Transformer-Based Personal Linguistic Embeddings Constructed from SMS History

Natural language processing (NLP) is a powerful set of tools which aim to predict features from text-based data. One such important feature of prediction is mental illness, as an accurate tool would empower preemptive health crises interventions. While this is a well-researched area within the field of NLP, few studies have sourced from text message (SMS) history. SMS history provides higher quality data, compared to the conventional alternatives (i.e. social media) due to its high volume and personal nature.

Here, we construct high-dimensional linguistic vectors from the linguistic embeddings of an individual's SMS history. Firstly, SMS history is extracted from the individual's phone, before data is cleaned for data processing. Then, various sentence Transformers are used to create linguistic embeddings of each message sent by the user. All of an individual's linguistic vectors are summed – after undergoing some frequency-based weighting – to construct a personal linguistic embedding.

Features of this high-dimensional linguistic embedding are then processed to predict personality traits and mental illnesses using a neural network and random forest classifier. Personality traits include Big 5 and various demographic information, while mental illnesses include depression, anxiety, and OCD.

Linguistic embeddings constructed in this same way are then constructed from data immediately preceding mental crises and compared to those linguistic embeddings outside of these mental crises using the same feature extraction and processing approaches to predict imminent crises.

Preliminary results show high accuracy during the prediction of personality traits and demographic information. Full analysis will be presented at MARCUS after its conclusion.

Mentor(s): Sujith Vijayan, Neuroscience, Virginia Tech

Yehya Hassouna
Virginia Tech/Plant Science

Culturing microbes from old cultivars of crops; Diversity hidden by time

The goal of our research was to determine if there was a difference in the bacteriome between different genotypes of crops, in our case corn. We hypothesized that there would be differences between the genotypes. To test this, we researched three different genotypes of corn (Funk's Yellow, B73, and Little Briton) and compared the bacteriome associated with each. To compare the bacteriomes, we extracted bacteria in two separate stages of root growth from both the inside and outside of the roots. We then grew the bacteria at 28°C. After isolating these samples, we processed them using a method called Fatty Acid Methyl Ester (FAME) extraction, which converted the fatty acids unique to the cell membrane of each bacterial species into methyl esters. These methyl esters were then identified in a gas chromatograph, which identifies the bacteria by comparing the methyl esters of each sample to a database of methyl esters known to belong to specific bacterial species. Our results indicate that there was a difference in the bacteriome of each genotype, dominated by members such as: Enterobacter, Bacillus, and Flavimonas. Next, we plan to extract ribosomal RNA (rRNA) from our samples to confirm our findings.

Mentor(s): Mark Williams, Plant and Environmental Science, Virginia Tech

Daisy Hernandez-Ramos
Virginia Tech/Psychology
Adriel Castro
Virginia Tech/Psychology
Natalie Castro-Martinez
Virginia Tech/Psychology

Sending Love: The Effects of Writing a Positive Personal Note on Subjective Well-Being

In our day-to-day lives we can often be distracted by the abundance of tasks we need to complete, and we often overlook those friends and colleagues around us. This can cause a decrease in interpersonal gratitude and reciprocation of good deeds, thereby influencing individuals to be less inclined to perform acts of kindness unless such behavior is extrinsically rewarded. This research evaluated how a random act of kindness might affect the subjective wellbeing (SWB) of the benefactor. For this study, 40 undergraduate students completed a mood survey at the beginning and end of a research class each week for three consecutive weeks leading up to the day of an intervention whereby the undergraduate students wrote a kind note to a stranger on a handmade Valentines-Day. A systematic analysis of the mood surveys indicated that the participants gave significantly fewer lower ratings of positive moods (e.g., happiness, motivation, fulfillment, etc.) after writing a kind note for a stranger than before. The text message written on each card was recorded and is being evaluated with a systematic text analysis. This study assessed how a person's SWB could be affected by writing a personal positive message to a stranger with both a mood survey and text analysis. At this point, it seems writing a positive note to a stranger increased SWB, but our analysis is still ongoing and further findings will be reported at the conference.

Mentor(s): E. Scott Geller, Psychology, Virginia Tech

Michael Himlin
Virginia Tech/English

Answering Jay McInerney's Question: The Loss of an Illusion vs. Living a Life of Illusion

In 1984, Jay McInerney published Bright Lights, Big City. The novel, which is written in the second person, follows the unnamed protagonist throughout his life in New York City; where he leads a life that is consumed by luxury, prestige, and lies. In the preface of the novel, the narrator asks the reader "which is worse: living an illusion, or losing it?" (McInerney). Bright Lights never directly answers this question, but I argue that the novel suggests living a life of illusion is significantly worse than losing it. This project answers the narrator's question by honing in on the main character's obsession with cocaine, the patterns behind his consistently challenging relationship with facts, and the path toward denouncing the superficiality in his life. His growth from battling these traits reveals his return to a conceptual state of modernism in a post-modern world. I also draw from secondary research that considers the correlation between illusion and the effects of modernism painted by McInerney in a post-modern world to explore how Bright Lights should act as a warning sign for a post-modern society. This process helps offer answers to the novel's early question and illuminates how living an illusion has a worse outcome than losing the illusion. Losing the illusion might be more painful in the short term; however, living an illusion is much more detrimental to a person's life through the loss of facts. The novel, as well as McInerney's literary cohort, the Literary Brat Pack, sends a message of a belief in modernism to a 1980s audience in a post-modern society.

Mentor(s): Geovani Ramírez, Department of English, Virginia Tech

Haley Hines
Virginia Tech/Biological Sciences

Understanding Tetrodotoxin Resistance and Na_V2 Channels in *Echinodermata*

Voltage-gated Sodium Channels (Na_V) are transmembrane proteins that are responsible for neurocellular communication by allowing sodium ions into the cell. Tetrodotoxin (TTX) is a naturally occurring neurotoxin used by many organisms as an antipredation defense. TTX binds to the pore region of Na_V1 channels eventually leading to neuromuscular paralysis and death if an organism is not resistant. To be resistant to TTX, organisms must contain specific mutation in their Na_V1 channel genes. This has been well studied in vertebrates, but not in organisms like marine invertebrates, like echinoderms. Echinoderms contain Na_V2 channels unlike most vertebrates, which only contain Na_V1 channels. To infer TTX resistance in Na_V2 channels, we curated a dataset of echinoderm Na_V2 sequences from GenBank. We then annotated, aligned, and created a gene tree to compare the sequences with amino acids known to confer TTX resistance in other groups. We found that all the echinoderms in our dataset have a D to N change which is known to be a highly resistant change in some populations of garter snakes. The only Na_V channel that echinoderms have is this Na_V2 channel, leading us to conclude that they have full body resistance to TTX; the only group we know of with this characteristic. Our next steps include running computational evolutionary analyses to estimate evolutionary rates and test different hypotheses of molecular evolution. We will also expand our dataset by collecting Na_V2 sequences from chordates like lampreys and lancelets to widen our scope of Na_V2

Mentor(s): Joel McGlothlin,Biological Sciences, Virginia Tech

Noelle Hodges
Virginia Tech/Biological Sciences

Cold Temperatures Influence Behavior and Pathogen Spread in House Finch Cagemates

Changes in temperature can affect the prevalence of animal behaviors that are often linked to the spread of a pathogen. In autumn and winter, house finches encounter a bacterial pathogen, known as Mycoplasma gallisepticum (MG), due to contacts with sick birds or contaminated bird feeders. It is thought that house finches congregate at bird feeders during colder temperatures to meet higher energy restraints, leading to potential exposure to MG. In this project, we studied how temperature influences certain behaviors (i.e. feeding) and if the birds that spent more time at the feeder would be more susceptible to MG. To determine how temperature can influence certain behaviors, we pair-housed birds in two rooms with distinct ambient temperatures (either winter temperatures, where birds have to expend energy to stay warm, or summer temperatures, where they do not). One bird, the "index", from each pair was inoculated with MG, while the cagemate was not infected. On day 10, we applied a fluorescent and transferrable powder around the conjunctiva of the index bird to simulate transmission of MG from the index bird to the cagemate . The following morning (day 11), during peak feeding time, we recorded feeding behavior in each cage for 1 hour and measured the amount of powder spread between birds immediately afterwards. Of this 1-hour recording, I observed 30 minutes of cagemate behavior, by measuring the time spent at the feeder and number of bill swipes. Results show that there is a significant increase in time spent on bird feeders and more powder spread in cold, winter temperatures. The results indicate that changes in climate can affect disease dynamics and behaviors in house finches.

Mentor(s): Dana Hawley,Biological Sciences, Virginia Tech
Sara Teemer-Richards, Department of Biological Sciences, Virginia Tech

Jacob Holloway
Virginia Tech/Psychology

Campus sexual assault email alerts: Do students find them helpful?

Amidst the alarming prevalence of campus sexual assault (CSA), college officials have implemented email alerts informing students of CSA. This multi-method study explored student opinions on the utility and communication effectiveness of these emails. Participants (n=274) completed an online survey assessing if students read CSA emails (yes=54%) and if the content was helpful (yes=46%). To assess the impact of the emails, students were asked whether they remembered the contents of the last email. While 54% of students reported yes, only X% were correct. Subsequently, students were prompted to report what was helpful and unhelpful about the emails. Using a thematic analysis approach, major themes indicated students found CSA emails helpful regarding resources, raising awareness of CSA and the circumstances in which it occurs. Furthermore, students reported that the emails lack accountability, prevention measures, sufficient content, effective structure, and can be triggering. Findings underscore the imperative need to integrate the unique needs, concerns, and perceptions of students into CSA policies and procedures. By offering a nuanced exploration of student opinions, these findings present actionable insights to enhance communication strategies prioritizing safety, inclusivity, and effective sexual assault prevention.

Mentor(s): Meagan Brem, Psychology, Virginia Tech
Allison Tobar, Psychology, Clinical Science Doctoral Student, Virginia Tech

Jacqueline Hou
Virginia Tech/Biochemistry

Super low-dose endotoxin reprograms neutrophils for targeted cancer treatment in vitro

As the first breakthrough in immunotherapy, “Coley’s toxins,” or the treatment of cancer through the injection of heat-killed bacterial endotoxin, has been under both curiosity and scrutiny due to the poor understanding of its mechanisms. This study reveals the novel reprogramming of innate immune neutrophils by bacterial endotoxin to an immune-enhancing anti-cancer state in vitro. Following in vivo studies which demonstrate that neutrophils trained by super-low dose lipopolysaccharide, or LPS, significantly reduce tumor burden, this study highlights the mechanisms in which the innate immune system can be trained to boost the anti-tumor ability of the adaptive immune system. LPS-primed neutrophils significantly enhance T-cell proliferation and amplifies cytokine production consistent with anticancer behavior in vivo. Moreover, we found that LPS-primed neutrophils stimulate NK cells by releasing them from the suppression state. LPS-primed neutrophils promote NK cell proliferation and enhance their tumor killing rate as measured by flow cytometry and lactate dehydrogenase levels. Altogether, these data elucidates the supposedly mysterious mechanisms behind endotoxin priming of the innate immune system as originally demonstrated by “Coley’s toxins,” further placing neutrophil-based immunotherapy as an effective method of treatment for cancer patients.

Mentor(s): Liwu Li, Biological Sciences, Virginia Tech
Yao Zhang, Department of Biological Sciences, Virginia Tech

Zachary Hubshman

Virginia Tech/Cognitive and Behavioral Neuroscience

Feasibility and Acceptability of the Couples Daily Diary Approach in Measuring IPV and Alcohol Use in Bisexual Couples

Current literature on intimate partner violence (IPV) has focused on heterosexual relationships, creating a gap in the literature on sexual-minority relationships. Bisexual people are at highest risk of experiencing minority stress, alcohol use, and IPV relative to other populations, underscoring the need for IPV research on this population. Exploring how daily minority stressors intersect with IPV and alcohol use in bisexual couples (couples where at least one partner is bisexual) will point to bisexual-specific IPV intervention targets, thereby enhancing the inclusivity of IPV intervention programs. Yet, a lack of evidence exists on daily experiences among bisexual couples; a critical first step toward uncovering proximal antecedents to IPV within this priority population involves determining whether daily diary methods can capture these experiences among bisexual couples. The purpose of the present study was to assess the acceptability and feasibility of a 60-day diary approach to capture daily IPV, alcohol use, and minority stress among bisexual couples. Fifteen bisexual couples (N=30 individuals) completed once-daily assessments of IPV, alcohol use, and minority stress for 60 consecutive days followed by an exit survey of acceptability. Compliance was good such that 93% of daily surveys were completed. During the 60-day study, 73% of participants experienced IPV, 76.7% experienced minority stress, and 100% consumed alcohol. Most (90%) participants were satisfied with study procedures, and no adverse events were reported. These findings suggest that couple daily diary approach is a viable method for capturing discrete IPV events, daily alcohol use, and daily minority stress among bisexual couples.

Mentor(s): Megan Brem, Psychology, Virginia Tech

Mila Ilijoski
Virginia Tech/Cognitive Behavioral Neuroscience

ASSOCIATION BETWEEN GENDER AND COGNITIVE FLEXIBILITY TRENDS IN 9-YEAR-OLDS.

ASSOCIATION BETWEEN GENDER AND COGNITIVE FLEXIBILITY TRENDS IN 9-YEAR-OLDS. M. Ilijoski, M.Zerrouk. M.A Bell. Psychology, Virginia Tech, Blacksburg, VA 24061 milai@vt.edu

Women exhibit greater cognitive flexibility compared to men, particularly in tasks requiring organization and planning activities (Lindsey & Collier-Baker, 2018). The association between gender and executive functions were examined with a special emphasis on cognitive flexibility. Our research observed at the phenomena in children at age 9. The study explored how behavioral measurements and questionnaires, namely the Behavior Rating Inventory of Executive Function (BRIEF) and cognitive flexibility evaluations, offer complementary insights into gender variations in executive functioning. Age 9 planning and organizational abilities were assessed using the BRIEF. Age 9 cognitive flexibility was assessed using the conceptual level task of the Wisconsin Card Sorting Test.

Independent Samples T-Tests for boys and girls were for WCST conceptual level and BRIEF planning and organization scores. Girls scored significantly higher than boys on the WCST conceptual level task $t(274) = 3.186$, $p = .002$. Additionally, girls scored significantly higher than boys on the BRIEF planning and organization scale $t(274) = 1.978$, $p = .049$ Results showed girls at age 9 have better cognitive flexibility and planning and organizational skills than boys. . These results may suggest early sex differences in executive functioning.

Mentor(s): Martha Ann Bell, Psychology, Virginia Tech
Mo Zerrouck, College of Science, Psychology, Virginia Tech

Sid Jakoubek
Advanced Studies Blacksburg High School Student

Investigating the Factors Which Allow for the Stability of Planetary Orbits in Binary Star Systems Using Numerical Simulations Based on Initial Planetary Positions

The purpose of this study was to find what requirements or necessities, if any, were needed for planets to form and hold a stable orbit within a binary star system by using simulations to model their orbits. The conclusion that was come to is that, from the simulations that have been run, a planet must, at minimum, be at a high distance from the center of gravity of the system in order to maintain a somewhat stable orbit. This conclusion has been reached by looking at the data gathered from simulations, which showed that the further the planet was from the center of gravity of its binary star system, the more likely it was to remain in the star system for longer periods of time. Coupled with the velocity of the planets, which got slower, the further away they went from the center of gravity, the more stable their orbits became. This shows that, in binary systems, the further away a planet is from the center of gravity of its system, the better the chance it has for it to remain within the system and hold a stable orbit.

Mentor(s): Katharine Davis, Science, Blacksburg High School
Dr. Rhett Herman, Prof. of Physics, Radford University

Brittany James
Virginia Tech/Public Health

Copula Absence Variation in New Orleans English

In English, a copula is the conjugated verb to be, usually is or are. Some dialects can variably omit the copula from a phrase, as in the sentence ‘she pretty’ or ‘they gonna go to the store’; this is known as copula absence. This feature is present in many regional dialects of English, in particular, in Southern varieties spoken by Black and white speakers alike, though there is evidence that constraints on variation may differ across ethnic groups. This study seeks to test trends in copula absence across three ethnic groups in New Orleans: Black, white, and Creole (a distinctive mixed race group in Louisiana with French and African heritage). Data from twenty-two speakers, balanced for gender, was examined for social and linguistic constraints on copula variation. A mixed effects logistic regression demonstrated that Black speakers use copula absence at a higher rate than speakers of other ethnicities, revealing that Creole speakers pattern more closely with white speakers in rates of usage. In addition, across the sample male speakers omit the copula more often than female speakers. Notably, Black, white, and Creole speakers all featured higher rates of are absence than is absence, in contrast with trends observed elsewhere in the South. Thus, the data confirm the systematicity of copula absence in New Orleans English while revealing some points of similarity, and some points of difference, in the copula absence systems of Black, white, and Creole New Orleanians.

Mentor(s): Katie Carmichael, English, Virginia Tech

Pujita Jethwani
Virginia Tech/Dairy Science

Improving the methodology for estimating ruminal fiber digestibility.

Fiber is an important part of a ruminant diet, protecting the animal from metabolic diseases and providing them energy. The quality of that fiber is an important thing for producers to be able to measure, and this is done by estimating its digestibility. Typically, this is done by placing samples in the rumen of cannulated animals and measuring how much of the fiber disappears in situ. However, this method sometimes results in unexplained observations. We conducted this experiment to find the source of such an observation, a biologically impossible immediate fiber digestion called Fraction A, in which the fiber immediately disappears at time zero. We incubated forage samples in porous bags within the rumen of dairy cows, extracted them at intermittent times, and washed them using either a washing machine or by hand. We then compared the amount of Fraction A observed with each technique. Results from this study show that the occurrence of Fraction A was dependent on the washing technique and forage sample. However, since Fraction A was observed in both washing techniques, the reliability of the in situ method was questioned and determined to require further research and improvement.

Mentor(s): Gonzalo Ferreira, Dairy Science, Virginia Tech

Lily Jo
Virginia Tech/Psychology

Age 3 and Age 6 Predictors of Age 6 ADHD behaviors

Temperament plays a fundamental role in ADHD (DePauw & Mervielde, 2011). Studies show that high negative affect (NA) is associated with ADHD symptoms and is a strong predictor of the severity of these symptoms (Alacha et al., 2024, Martel et al., 2014). Surgency, defined as high levels of sociability, is found to predict ADHD symptoms in preschool age children (Kerner auch Koerner et al., 2018). Children with low levels of effortful control are more likely to exhibit symptoms of ADHD (Kostyrka-Allchorne et al., 2023). We examined whether surgency, negative affect, and effortful control at ages 3 and 6 predicted ADHD symptoms at age 6. Maternal report via the CBQ was used to measure effortful control, negative affectivity, and surgency. Mothers reported ADHD behaviors via the CBCL. Regression analyses were conducted via SPSS 26. Regression model 1 for age 3 showed that effortful control (beta= -.262, p= .001), negative affectivity (beta= .174, p= .007), and surgency (beta= .221, p= .001) were significant predictors for ADHD symptoms at age 6. Regression model 2 for age 6 showed that effortful control (beta= -.351, p= .001), negative affectivity (beta= .290, p= .001), and surgency (beta= .263, p= .001) were significant predictors for ADHD symptoms at age 6. Results show the importance of analyzing the impact of temperamental predictors of ADHD symptoms in different points of early childhood.

Mentor(s): Martha Ann Bell, Department of Psychology, Virginia Tech
Mohamed Zerrouk, Department of Psychology, Virginia Tech

William Jones
Virginia Tech/Geography

Music Accessibility: A Quantitative Investigation of Spatial Accessibility to 50 Classical Music Pieces

The purpose of this study is to visualize the spatial distribution of classical music performances and identify spatial patterns by focusing on 3,108 counties in the contiguous United States. In other words, we aim to investigate the socio-spatial patterns of accessibility to classical music performances by using GIS. Fifty concertos and symphonies (e.g., Beethoven's Symphony No. 9, which is commonly known as Ode to Joy) that were listed as American's favorite classic pieces were chosen for analysis in this study. The results demonstrate the clear spatial disparity in music accessibility. Using the hurdle model, which is a combination of multiple linear regression and binary logistic regression to address zero-inflated data, results indicate that counties with higher population densities and higher percentages of educated populations are significantly associated with higher music accessibility. Moreover, maps demonstrate the remarkable regional disparities in music accessibility: Midwestern counties show much poorer accessibility than counties on the West Coast and East Coast.

Mentor(s): Junghwan Kim, Geography, Virginia Tech

Poojaa Kalathur
Virginia Tech/Clinical Neuroscience

Targeted Removal of Dnm1 Mutation Rescues Epileptic Phenotypes in a Mouse Model of Childhood Epilepsy

Developmental and epileptic encephalopathies (DEEs) are a group of childhood disorders characterized by severe seizures, developmental delays, and abnormal electroencephalogram (EEG) patterns. Dynamin-1 (Dnm1) is a presynaptic GTPase protein that facilitates synaptic vesicle fission, and missense mutations in Dnm1 cause DEEs. Mice with the mutation A408T (Fitful/Ftfl) serve as a phenotypic model of the condition. Heterozygous Ftfl mice exhibit spontaneous and handling-induced seizures, abnormal behavioral displays, and neural hyperexcitability. To better understand neuronal cell types underlying seizure phenotypes in this model, we created a mouse where the exon containing the Ftfl mutation can be removed with Cre expression. We found that deletion of the Ftfl exon from SST-Cre-expressing interneurons rescued mice from handling-induced seizures. We then hypothesized that deletion of the Ftfl exon from SST-Cre interneurons would also reduce spontaneous seizure frequency and epileptic behaviors. We recorded 72 hr video-EEGs on heterozygous Ftfl mice (Dnm1_A408T/WT), wild-type mice (WT/WT), mice with removal of Ftfl from SST-interneurons (Dnm1_A408T/SST_Cre) and analyzed the footage for spontaneous seizures and epileptic behaviors. Data analysis showed that Dnm1_A408T/SST_Cre mice showed no spontaneous seizures and reduced epileptic behaviors. This study provides insight into Dnm1-related DEEs and identifies a neuronal population that may serve as a target to treat the condition.

Mentor(s): Matthew Weston, School of Neuroscience, Fralin Biomedical Research Institute, Virginia Tech
Amy N. Shore, Center for Neurobiology Research, Fralin Biomedical Research Institute, Virginia Tech
Pranav P. Mathkar, School of Neuroscience, Fralin Biomedical Research Institute, Virginia Tech

Poojaa Kalathur
Virginia Tech/Clinical Neuroscience

Exploring the Role of Maternal-Child Interactions in the Development of Child Attention Problems

ADHD or Attention-Deficit Hyperactivity Disorder is a common neurodevelopmental disorder characterized by symptoms like inattention, hyperactivity, and impulsivity. Previous studies have indicated that ADHD is associated with problematic family functioning and conflicted parent-child relationships (Deault, 2009). During interaction tasks, parents of children with ADHD used fewer positive affect words than parents of children without ADHD, suggesting these behaviors may shape or progress ADHD behaviors (Musser et al., 2018). Higher quality maternal caregiving behavior (MCB) has been associated with fewer ADHD symptoms in both boys and girls, but later ADHD symptoms are predicted by lower MCB (Miller et al., 2018). This study examined relations between mother-child interactions and child attention problems from a longitudinal perspective. Given sex differences in ADHD, we included sex in our analyses. Preliminary results show moderate relations among attention problem measurements between four time points measured from 3 to 9 years of age, and correlations were seen with child sex and attention problems, with females demonstrating less attention problems at the different ages. Future directions would examine common comorbidities of ADHD like ODD (Oppositional Defiant Disorder) and anxiety disorders and whether maternal-child interactions influence the progression of these as well.

Mentor(s): Martha Ann Bell, Psychology, Virginia Tech
J. Douglas Harrison, Jr., Psychology, Virginia Tech

Aditya Kapoor
Virginia Tech/Clinical Neuroscience

Enhancing Double-Blind Clinical Trials in Neuromodulation: A Novel Application of 3D-Printed Thermoplastics and High-Density Gel Matrices in Low-Intensity Focused Ultrasound

Low-intensity focused ultrasound (LIFU) is a promising non-invasive neuromodulation technique for modulating various cortical and subcortical brain regions with high spatial precision. However, the advancement of LIFU into clinical applications is hampered by the challenge of conducting double-blind clinical trials, primarily due to the experimenter being aware of the condition applied. This study introduces a novel method to facilitate double blinding using a combination of 3D-printed thermoplastics and high-density gel matrices. We employed thermoplastic polyurethane (TPU) and Acrylonitrile Butadiene Styrene (ABS) to create visually identical discs with varying acoustic properties, integrated into gel matrices, to serve as either active or sham couplants for LIFU experiments. The acoustic characteristics of these discs were empirically tested in an acoustic test tank using a single-element 500 kHz focused ultrasound transducer. We assessed the pressure attenuation and beam profile distortion using a calibrated needle hydrophone. Subsequent variability testing on multiple prints of the selected best treatment and active sham discs validated the consistency of the acoustic properties and demonstrated minimal fluctuations in the manufacturing process. Preliminary findings demonstrate the sham disk within gel resulted in a 94% pressure attenuation (as compared to free water scans) and the verum disk (still being analyzed in-gel condition) resulted in a 8% pressure attenuation (without being imbedded in the gel) despite being visually identical. Thus, these novel coupling media provide an effective way to double blind human LIFU studies. The results of this study will increase rigor in future human studies by providing a new, easily employable, and cost-effective method to double-blind studies that previously was difficult to do.

Mentor(s): Wynn Legon, School of Neuroscience; Fralin Biomedical Research Institute, Virginia Tech

Thiviya Karuppasamy
Virginia Tech/Microbiology

Exploring Human and Plant Interactions in the Built Environment

Growing edible plants in public spaces, particularly K-12 and University classrooms, could help reduce carbon dioxide emissions from buildings and combat food insecurity while appealing to the public's sense of aesthetics and fostering a soothing, albeit productive, environment. However, growing plants in public settings puts them at risk of disease due to possible exposure to plant pathogens; additionally, publicly grown plants could present a health risk when consumed because of their possible contamination with food-borne pathogens by the people frequenting the public space where the plants are grown. Potential risks for plants and humans can be assessed through analysis of indoor airborne microbes in classrooms with or without plants, as well as observation of plant microbes in rooms with or without human access. For this study, (1) plants were grown in hydroponic systems in a University classroom, (2) students and staff were instructed on interacting with the plants to different degrees, or not at all (3) DNA was extracted from collected plant samples for 16S rRNA sequencing, and (4) taxonomic composition of plant-associated microbial communities is being analyzed to determine the presence of potential plant and human pathogens. The plant microbiomes are expected to be minimally affected by humans in the absence of direct contact, intermediately affected by air droplets, and strongly affected by touch. Challenges in executing this study and preliminary results will be discussed.

Mentor(s): Boris Vinatzer, School of Plant and Environmental Sciences, CALS, Virginia Tech

Georgia Katsapis
Virginia Tech/Biological Sciences, Biomedical Option
Ziyu Zhang
Virginia Tech/Human Development
Chloe Guenette
Virginia Tech/Human Development
Haley Johnson
Virginia Tech/Human Development

Lifestyle factors and physical biomarkers that predict cognitive outcomes in later life

Cardiovascular disease and health are risk factors for and may contribute to the development/progression of Alzheimer's Disease (AD) (Leszek et al., 2020). Our goal was to better understand how several physical health biomarkers and health behaviors, which usually predict cardiovascular health, predict general, cognitive health over a span of ten years. We drew our dataset from the Health and Retirement Study (HRS), a large nationally representative study including approximately 20,000 participants over the age of fifty across the United States conducted by the University of Michigan biennially since 1992. Within the HRS, we utilized the core dataset as well as the 2006 Blood Spot biomarker measures. We examined three lifestyle factors: sleep, physical activity, and smoking as well as four physical biomarkers: Hemoglobin A1C, C-Reactive Protein (CRP), Total Cholesterol, and Cystatin C. After collecting our data, we used separate regression models, with cognitive functioning as the dependent variable and gender, age, and years of education as covariates, to predict global cognitive functioning among a group of older ad..ults. We found that for each variable the models were adequate between 0.22 and 0.29 adjusted R-squared. We also found that each lifestyle factor, except for physical exercise, and each health biomarker, was significant with p-values <0.05. These findings have significant implications for clinicians and other health professionals who may engage in the promotion of health behaviors targeting improved cognitive functioning in later life, to better optimize cognition in later life.

Leszek, J., Mikhaylenko, E. V., Belousov, D. M., Koutsouraki, E., Szczechowiak, K., Kobusiak−Prokopowicz, M., Mysiak, A., Diniz, B. S., Somasundaram, S. G., Kirkland, C. E., & Aliev, G. (2020). The Links between Cardiovascular Diseases and Alzheimer's Disease. Current Neuropharmacology, 19(2), 152–169. https://doi.org/10.2174/1570159x18666200729093724

Mentor(s): Benjamin Katz, Human Development and Family Science, Virginia Tech
Elayna Seago, Human Development, Virginia Tech,

Madeline Keene

Virginia Tech/Wildlife Conservation

The Role of Parental Care in Avian Sexual Dichromatism

In birds not all adult individuals of the same species are similarly colored. This is a result of sexual dichromatism, where one sex is different in color than the other sex. One of the leading hypotheses behind this coloration difference is that female birds evolved cryptic coloration to avoid predation while rearing offspring (Wallace, 1891). This hypothesis contrasts with the theory of sexual selection, where the inequality in color between sexes is driven by females selecting for brighter, more colorful males through mate choice (Darwin, 1871). Is sexual dichromatism primarily driven by a loss of color in females, or due to an increase in male color? We theorize that monochromatism is ancestral to Aves with both sexes equal in color and parental care, and that sexual dichromatism arises in birds due to unequal investment in offspring between the sexes resulting in different selection pressures on the parent's color. Using the book "All the Birds of the World" by Lynx publishing we collected the sexual dichromatism data of approximately 3,000 species of birds, labeling them as monochromatic or dichromatic, and ranking their degree of dichromatism. We then compared these data with the parental behavior of incubation and offspring feeding, determining if these two behaviors were male biased, female biased, or bi-parental.

Mentor(s): Ignacio Moore, Biological Sciences, Virginia Tech

Megan Kesler
Virginia Tech/Animal Science

OmniGen-AF Supplementation to Improve Ovum Pickup and Embryo Yield in Cattle

Assisted reproductive technologies can be used to improve genetic selection. One method is ovum pick-up (OPU) that collects cumulus oocyte complexes (COC) from live females. The main challenges associated with OPU are the reduced oocyte yield and quality that leads to inefficient embryo development through in vitro production (IVP). Our work focuses on improving the quality and quantity of oocytes coming from donor cows. OmniGen-AF® (OG) is a feed supplement that decreases the stress response in cattle, but limited research has identified how it impacts the reproductive system. Our work proposes that OG supplementation in beef cattle will improve COC quality. Commercial cows (n=7/treatment) were sorted into two groups based on breed and body condition. The control and OG group were fed a base diet of 1 kg cracked corn and 30 g molasses, adding 56 g for the OG group. Diets began 28 days prior to the start of OPU. Diets were maintained through OPU collections that were conducted twice a week for 5 weeks. Total follicle numbers, follicle diameters ≥5mm, and COC quality were recorded at each OPU session with follicular fluid collected once weekly. These datasets were analyzed using GLM procedure in SAS. The treatment group did not influence the number of follicles or COC retrieval rates. However, OG supplement reduced the mean diameter of the largest follicle and overall mean follicle size. There were no effects of treatment on COC quality. Our work is ongoing as follicular fluid metabolic composition is being analyzed.

Mentor(s): Alan Ealy, Animal Sciences, Virginia Tech
Jessica Keane, Animal Sciences, Virginia Tech

Dana Kim
Virginia Tech/Biochemistry
Kayla Maggard
Virginia Tech/Biochemistry
Yumi Kim
Virginia Tech/Biochemistry

Observing Favorability of Different Opioids Bound to the μ-Opioid Receptor

The μ-opioid receptor is a g-protein receptor found within the brain and spinal cord. Naloxone, also known as Narcan, is an antagonist medication administered to reverse an opioid overdose. Naloxone competes with the opioids bound to the μ-opioid receptor. Studying the binding pocket of the μ-opioid receptor can allow drug manufacturers to better develop opioid overdose treatment. Fentanyl and Naloxone binding in the μ-opioid receptor were compared to further examine the binding pocket, with Naloxone expected to have a higher binding affinity to the receptor due to its clinical use in overdose reversal. Molecular docking was performed to compare and investigate binding affinities. Our results show fentanyl displayed higher values of binding affinity compared to the μ-opioid receptor than Naloxone. These results could inform the design of compounds that can better reverse opioid overdoses. Further research would be required to determine if administering multiple doses of Narcan would have better outcomes in reversing a Fentanyl overdose.

Mentor(s): Anne Brown, University Libraries, Virginia Tech

May Kretzer
Virginia Tech/Experimental Neuroscience
Caleb Townsend
Virginia Tech/Experimental Neuroscience

Effect of Caffeine on Associative Memory in C. Elegans

Caffeine is the most widely consumed drug worldwide, affecting alertness and physiological activity. Many college students rely on caffeine to improve their memory retention and focus during studying. As such, many experiments have attempted to assess caffeine's effect on cognitive abilities, particularly learning. However, there have been inconsistent results regarding the efficacy of caffeine on learning and memory. In humans, these inconsistencies might be due to psychological factors, such as the placebo effect. Thus, we aim to distinguish between the biological and psychological effects of caffeine by using a model organism that does not have the cognitive complexity for placebo effects. Our team identified C. elegans to assess the effect of caffeine on associative learning. C. elegans are an organism with a simple nervous system, and they can form memories associating environmental olfactory information with positive or negative conditions, such as starvation or the presence of food. This, in addition to them being easy to grow and maintain, makes C. elegans an ideal model organism to study effects of caffeine exposure on learning. We are investigating the effects of acute caffeine exposure on C. elegans' associative memory by placing them in a caffeine or control solution immediately before training them to associate the scent of butanone with the presence of food. We will then perform a chemotaxis assay allowing them to travel towards butanone or ethanol (vehicle) to investigate how many retain a positive association with butanone. We predict that animals exposed to caffeine before the training period will retain this association at a greater rate than those not exposed to caffeine. This will be calculated with a Chemotaxis Index formula. After obtaining results, we will compare the rate at which caffeine-exposed and control C. elegans are attracted to butanone, and if the caffeine-exposed C. elegans are significantly more attracted to butanone, this would verify our hypothesis.

Mentor(s): Jennifer Rainville, School of Neuroscience, Virginia Tech

Ryan Krzysik
Virginia Tech/Business Information Technology - Cybersecurity Management and Analytics

The Next Generation of War

Technology has given the world many benefits, but those same technologies could give us unnecessary world conflicts. An example would be the Russian invasion of Ukraine that began on February 24, 2022, and continues to this day. While both countries are utilizing traditional war technologies, they are also prioritizing the use of the cyber world. Russia and Ukraine are pushing the limits of cyber attacks in their strategies to win no matter what their effects are on the current and future world. The goal of this research is to discover how cyber warfare in the Russo-Ukrainian war affects the world and what the world can do to prepare itself for the future. Research has been collected through numerous academic papers and personal interviews from a cybersecurity specialist and manager for over 20 years and a Ukrainian civilian with first-hand experience of the start of the Russian invasion. The results from the research will emphasize the importance of cyber warfare and the necessity to write and create international laws that will limit this method of warfare for generations to come.

Mentor(s): Katie Thomas, School of Communication, Virginia Tech

Sophia Kutz
Virginia Tech/Biochemistry
Kate Mastrolia
Virginia Tech/Biochemistry
Kira Peters
Virginia Tech/Biochemistry
Jasmine Traynor-Hawk
Virginia Tech/Biochemistry

Effectiveness of Cefotaxime and Ceftriaxone as Beta-Lactamase Inhibitors

With the proliferated use of antibiotics, gram-negative bacteria have developed increasingly effective antibiotic resistance proteins. In order to combat this resistance, new solutions are necessary. Beta-lactamase is an enzyme created by bacteria that hydrolyzes the beta-lactam ring of antibiotics to render the antibiotic inactive. As bacteria become more resistant to beta-lactam antibiotics, there is an increasing need to prescribe beta-lactam inhibitors in addition to antibiotics for treatment. There are currently several small molecules that inhibit beta lactamase, but new solutions must be created to withstand increased antibiotic resistance. Molecular docking was used to probe the affinity of cefotaxime to the beta lactamase protein and to compare it to the affinity of the inhibitor commonly used in antibiotics, ceftriaxone. Ceftriaxone has a more favorable binding affinity for beta lactamase of -8.9 as compared to the binding affinity of cefotaxime of -7.6. Therefore, cefotaxime is not a more effective inhibitor against beta lactamase. Ceftriaxone binds more effectively to beta lactamase because the bonds between the ligand and protein have shorter angstrom lengths, producing stronger bonds. The search for a new inhibitor against beta lactamase is crucial for the future of medicine as antibiotic resistance is on the rise. Although cefotaxime was not a better option than ceftriaxone, further research and testing of similar inhibitors should continue.

Mentor(s): Anne Brown, Library Department, Virginia Tech

Sage Lahmers
Advanced Studies Blacksburg High School Student

Relationship Between Below Ground Biomass and Soil Organic Matter: a Case Study in Mt Tabor, Blacksburg

The relationship between soil organic carbon and below ground biomass is a very important one. This study examined this relationship by sampling above ground biomass and soil organic matter. The null hypothesis was no relationship would be identified between soil organic matter and below ground biomass. The alternative hypothesis was that a direct relationship between soil organic matter and below ground biomass would be observed. The above ground biomass was used to create an estimation of the below ground biomass. Using linear regression, it is possible to examine how closely this relationship may exist. 31 samples were taken along the Mount Tabor area of Blacksburg, Virginia. This specific area serves as a case study for what could be a broader relationship. However, further research would need to be completed to prove this. A low R-squared value of 0.031 was found, suggesting that there isn't a significant relationship present. There is also an examination of other factors that could relate to soil organic matter, such as soil type or slope. Many uncontrollable variables may have outsized influence on the results.

Mentor(s): Brian Strahm, Forest Resources and Environmental Conservation, Virginia Tech
Katharine Davis, Research Teacher, Blacksburg High School

Colin Larkin
Virginia Tech/BioChemistry
Benjamin Sapperstein
Virginia Tech/Biological Systems Engineering
Julianna Frerichs
Virginia Tech/Biochemistry
Allison Brant
Virginia Tech/Biochemistry
Julia Richardson
Virginia Tech/Biochemistry

Mutation of TRP-81 on Ligand Binding Affinities in Acetylcholinesterase

Acetylcholinesterase is an enzyme which degrades acetylcholine in the human body while regulating transmission and signaling at neuromuscular junctions. Acetylcholinesterase malfunction has been seen in connection to Alzheimer's Disease (AD). Analysis of acetylcholinesterase's binding site and amino acid residues will provide data relevant to medical applications including the treatment of AD. The ligand Huperzine-A (HUP-A) is commonly used in pharmaceuticals for the treatment of AD symptoms. The affinity of TRP-81 in the binding site of acetylcholinesterase to HUP-A is not well understood. Increased understanding of HUP-A and acetylcholine interactions will allow for improved pharmaceutical development for AD symptoms. For this experiment, HUP-A was redocked before and after the mutation of TRP-81 into alanine, histidine, and glutamate to observe changes in binding affinities based on size, polarity, and charge differences. The intermolecular affinities between the ligand and binding site were made weaker and the average distances between the ligand and the active site increased. This indicates that TRP-81 is an essential residue in the binding site of acetylcholinesterase. The broad implication of our results is that TRP-81 is a key contributor to the ability of HUP-A to bind to acetylcholinesterase. Drugs aiming to treat AD should target interactions between the pharmaceutical ligand and TRP-81. Further steps would include analyzing other amino acid interactions and determining which contribute in an analogous way to TRP-81.

Mentor(s): Anne Brown, University Libraries, Virginia Tech

Caroline Larsen
Virginia Tech/Electrical Engineering
Emory Gleason
Virginia Tech/Mechanical Engineering
Roussell St. Laurent
Virginia Tech/Physics

eneration and imaging of acoustic resonant modes in vibrating sheet for nondestructive testing applications

Nondestructive testing (NDT) is essential for detecting internal flaws in safety-critical components, but existing NDT techniques are often costly, slow, or unsuitable for inspecting complex material structures. The goal of this project is to develop a novel NDT method which utilizes acoustic resonance. At specific frequencies, a mechanical system vibrates at normal modes with characteristic vibration patterns. Changes to the system's structure, such as internal defects, create changes in these characteristic patterns which can be recorded and amplified by an image processing system. This project has three main stages: physical generation of mode patterns in an aluminum sheet, validation in simulation of those patterns, and video processing of changes in the mode patterns. The result will be a proof-of-concept Acousto-Optic Nondestructive Inspection (AONDI) imaging technique for rapidly analyzing components at low cost.

Mentor(s): David Gray, College of Engineering, Virginia Tech

Jace Laska
Virginia Tech/Psychology

Predicting the Disordered Social Media Use: The Role of Attention, Home Environment, and Self-Regulation.

The proliferation of smartphones over the past decade has generated serious conversation about the negative impacts of chronic usage. Especially concerning is the use of social media, which has been correlated with depressed mood. We examined attention, temperament and household predictors of disordered social media. In particular, we explore attention problems, attention capacity, temperamental self-regulation, and household dysfunction as predictors of preoccupation with social media, withdrawal from social interaction, and escapism. Interestingly, we found no significant predictors among our selections, nor was the overall model significant. We conclude that disordered social media use may emerge from external social or environmental factors that are not based on a negative home environment, or individual differences in self-regulation and attention.

Mentor(s): Martha Ann Bell, Psychology, Virginia Tech
J. Douglas Harrison, Jr., Psychology, Virginia Tech

Arley Lausin

Virginia Tech/Environmental Conservation and Society

Walking Route Greenery & Student Well-Being

Many studies have been conducted establishing a positive relationship between spending time outdoors and your overall mood. Through this research I aim to investigate this relationship in the Virginia Tech student community. Does the amount of green space you encounter on your walk to campus affect your overall well-being as a student?

The purpose of my research is to explore the relationship between walking route greenery and student well-being. I will be recruiting Virginia Tech undergraduate students from a variety of majors and grade levels, who predominantly walk to campus, to participate in this study.

Participants will complete a travel diary, marking the routes they walked to campus each day on a map for four consecutive school days. They will indicate their mood after completing their walk to campus using the Travel Mood Scale.

The walking routes will be analyzed using ArcGIS to determine the amount of green space the subject encountered on their trip. This data will be compared to their mood to assess the relationship between footpath green space and the overall well-being of students.

Mentor(s): Michael Sorice, Department of Forest Resources and Environmental Conservation (CNRE), Virginia Tech
John Gannon, Department of Forest Resources and Environmental Conservation (CNRE), Virginia Tech
Steve Hankey, Urban Affairs and Planning (SPIA), Virginia Tech

Grace Lawrence
Virginia Tech/Psychology

A comparison of treatment duration, outcome, and working alliance between clients with Post Traumatic Stress Disorder (PTSD) and without PTSD in a community mental health clinic

The broad impact of traumatic experiences on individuals is evident, with about 70% of the world's population having faced at least one such event in their lifetime (Kazlauskas et al., 2017). While various evidence-based therapies are available for individuals diagnosed with PTSD, these individuals are reported to encounter barriers such as treatment anxieties, relational safety, and ineffective communication (Chadwick & Billings, 2022). We hypothesized that clients with PTSD would require a longer duration of therapy, resulting in poorer outcomes and display lower alliance than those without PTSD.

Participants included 18 clients diagnosed with PTSD and 18 clients without PTSD or history of trauma (N = 36). PTSD clients were 17 to 57 years old (M = 29.44; SD = 2.83), largely female (n = 12, 67%), and White (n = 10; 56%). Non-PTSD clients were paired based on gender, age, and race. Change scores on the Brief Adjustment Scale-6 (BASE-6) were generated to explore differences in intake and discharge symptomatology and functioning, calculated as: [intake score] - [discharge score].
Treatment duration and outcome were evaluated using independent t-tests. PTSD clients had a longer duration of stay in the clinic than non-PTSD clients ($t = 1.82$, $p = .08$). Change scores of the PTSD group did not demonstrate significant difference when compared to the non-PTSD group ($t = .085$, $p = .933$).

Results suggest potential barriers faced by clients with PTSD may affect treatment duration, but not significantly hinder treatment outcomes. Data is continually collected on therapeutic working alliance, and final results are subject to change.

Mentor(s): Lee Cooper, Psychology, Virginia Tech

Minhyung Lee
Advanced Studies Blacksburg High School Student

The Causes of Spontaneous Firing of Cardiac Muscle and Effects of Ion Concentration

Although, with my current knowledge regarding the heart and its mechanisms, we know that the heart is able to synchronize, we don't know what allows this to occur. Previous research showed that this was caused by a multitude of ions flowing through the channels between each cardiomyocyte. However a new theory that this project is looking to prove is that the synchronization comes from the gaps between the cardiomyocytes called the perinexus. This occurs from ions all creating a similar gradient between each cell that fluctuates at a rate similar to all of its neighboring cells, making the cells all reach their action potential at the same or similar times. This was done through isolation of atrial cells that underwent imaging after being prepped through chemical and mechanical digestion. My initial testing does show that there is a larger connection between the action potential and the ions traveling through the perinexus instead of the gap junctions. This was tested with different concentrations of ions with a baseline of a .5 M solution, which then was concentrated to a .7 M solution, diluted down to a .2 M solution, and then finally repeated at a .5 M solution to confirm if the variety of results was in fact coming from the differences in concentration and not an outside variable that was unaccounted for.

Mentor(s): Steven Poelzing, Fralin Biomedical Research Institute, Virginia Tech

Brianna Leon
Virginia Tech/Psychology

Understanding the Relations between Moral Conversation with Parents and College Student' Prosocial Behaviors: The Mediating Role of Empathy

Prosocial behaviors are voluntary actions intended to benefit others (e.g., helping and sharing; Eisenberg et al., 2015). Developmental scholars have suggested that prosocial parenting practices, like parents' conversations with their youth about moral issues, play an important role in their youth's prosocial and moral development (Lapsley & Carlo, 2014). Empathy, the ability to understand and share the emotions of others, is also positively associated with both parenting practices and prosocial behaviors (Eisenberg et al., 2015). Moral conversations with parents might foster youth's ability to empathize with others, thereby enhancing their engagement in prosocial behaviors. Previous studies have examined these associations among adolescents (Carlo et al., 2007). This study examines the mediating role of empathy in the association between moral conversations with parents and five distinct types of prosocial behaviors among college students. The sample was 324 midwestern college students (Mage = 19.47; 84% White/European American; 80% female). Path analysis revealed significant relations between moral conversations with parents and prosocial behaviors through empathy. Specifically, moral conversations with parents are positively associated with empathy, which, in turn, positively associated with emotional, dire, compliant, and anonymous but negatively associated with public prosocial behaviors. These findings contribute to our understanding of the mechanisms underlying college students' prosocial behaviors and highlight the importance of moral conversations with parents as well as fostering empathy within the family context for promoting positive social outcomes among college students.

Mentor(s): Zehra Gulseven, Psychology, Virginia Tech
Bengisu Nisa Aras, Psychology, Virginia Tech

Alexander Li

Advanced Studies Blacksburg High School Student

Enhancing Driving Safety via Real-Time Suppression of Vehicle Radar Interference

Automotive radar is a critical element within advanced driver assistance systems (ADASs). The real-time and accurate data provided by automotive radar systems are integral to the functionality and effectiveness of these ADAS features, making them a critical component in preventing accidents and enhancing driver safety. As the prevalence of automotive radars increases in vehicles, the interference among these systems poses a significant challenge, potentially compromising the accuracy of target detection and driving safety. An interference mitigation algorithm is necessary to minimize interference impact under highly dynamic driving conditions while adhering to strict processing time constraints. This paper introduces a real-time interference mitigation algorithm based on compressed sensing for Frequency Modulated Continuous Wave (FMCW) radar systems. My algorithm, called Soteria, leveraging signal sparsity in the frequency-time domain, identifies and separates interference signals from intended ones using the Compressive Sampling Matching Pursuit (CoSaMP) technique. Exploiting correlations between data from adjacent time slots optimizes CoSaMP's search space, enhancing efficiency. Moreover, the algorithm employs GPU computing architecture for parallel implementation, further accelerating computation. Simulation experiments demonstrate the algorithm's capability to achieve processing times of ~10 milliseconds, surpassing state-of-the-art algorithms in enhancing target detection accuracy

Mentor(s): Thomas Hou, Electrical and Computer Engineering, Virginia Tech

Isabella Liu
Advanced Studies Blacksburg High School Student

The Impact Comparison of Artificial Intelligence on Different Occupations in the Labor Market

With rapid development, artificial intelligence (AI) not only provides people with great convenience, but partly replaces human resource work and generates considerable concerns in the labor market. Although repetitive low-skilled jobs are considered to be substituted first by AI, the emergence of ChatGPT, AI painting, and other new technologies suggests that high-skilled jobs are also at risk of being replaced. This study argues that considering the various work content and nature of each industry, AI has different uses and impacts on different industries; in some businesses, AI may even provide more existing and new job opportunities in the labor market, which leads to inequality across industries. This study identifies the potential pattern for AI effects on various industries by analyzing relevant data from the US Bureau of Labor Statistics and International Labor Organization. This study will explore various industries based on the International Classification of Occupations' classification, comparing the impact of AI on different industries from aspects such as unemployment rate, salary, and changes in human job skills. The focus of this study is to define the gap between the impact of artificial intelligence on employment in various industries. I came to the conclusion that high-skilled workers will have a lower probability of being replaced by artificial intelligence, while low-skilled workers will have a higher probability of being replaced by artificial intelligence. This study also proposed some solutions to solve the gap by analyzing the differences in impact. By identifying which industries are most negatively affected by artificial intelligence and which industries benefit the most from artificial intelligence, governments and related agencies can better make policies and aid to safeguard the interests of the former and limit the latter's access to excessive resources. Doing so can address industry inequalities and create a better society where AI exists.

Mentor(s): Katharine Davis, Blacksburg High School

James Logan
Virginia Tech/Biological Sciences
Emma Lucier
Virginia Tech/Biological Sciences
Peyton Penland
Virginia Tech/Environmental Science
Alejandra Flota
Virginia Tech/Water Resources Policy and Management
Jialin Huo
Virginia Tech/Biological Sciences

Differences in Water Quality Above and Below a Retention Pond: Implications for Ecosystem Health and Predicted Effects of Dredging

Retention ponds, such as the Duck Pond at Virginia Tech, are constructed to manage stormwater runoff and flooding to improve downstream water quality. As Blacksburg and Virginia Tech's campus grows, the Duck Pond will be increasingly important for reducing downstream sediment and nutrient loads into Stroubles Creek and the New River. An upcoming dredging will remove sediments from the Duck Pond to hopefully improve the pond's retention efficiency. Currently, there is limited research on the effects retention ponds have on water quality, especially during dredging. We investigated water quality in Stroubles Creek above and below the Duck Pond to address the current retention efficiency of the pond and predict how nutrient removal capacity may change after dredging. To characterize nutrient and sediment removal within the Duck Pond, we tested for differences in water quality among the two inlets and the outlet of the pond. We used grab samples and sensor data to measure dissolved organic carbon (DOC), nitrate (NO3), ammonium (NH4), phosphate (PO4), specific conductivity (SpC), and turbidity (TURB). DOC and NH4 are often higher downstream of the pond, while NO3 is lower, suggesting biological processing. PO4 was higher at one of the inlets and less variable downstream. SpC was higher in the inlets, while TURB was higher at the outlet. Differences between the inlets and the outlet were significant for DOC, NO3, NH4, and SpC ($p < 0.05$). Future work will calculate nutrient loads into the pond to assess pond removal efficiency and predict how dredging may improve nutrient removal and water quality.

Mentor(s): Erin Hotchkiss, Biological Sciences, Virginia Tech
Katherine X. Perez-Rivera, Biological Sciences, Virginia Tech,

Andres Lopez
Virginia Tech/International Studies

Investigating merger of marginally contrastive conditioned vowels: Perception and production of pre-lateral FOOT and STRUT class words.

The distinction between the vowels in words like book /ʊ/ and buck /ʌ/ is present in the majority of English dialects. Pre-laterally, however, both /ʊ/ and /ʌ/ are in complementary distribution and have no minimal pairs. Past studies suggest that some speakers lose this distinction in pre-lateral environments, though this observation has mostly come from accidental or marginal findings, with Labov Ash & Boberg (2006) labeling this "merger" as "requiring further study" (73). This study systematically investigates the distinction between the FOOT and STRUT vowels pre-laterally in Virginian English speakers, looking both at production and perception. The 24 participants in this study read aloud a word list that included instances of /ʊl/ and /ʌl/ in monosyllabic words. Responses were analyzed acoustically, and the Euclidean distance between average /ʊl/ and /ʌl/ pronunciations in formant space was taken. Afterwards, participants completed a pile-sort task, where they were asked to categorize words into groups based on whether or not they contain the same vowel sound. Based on their sorting patterns, participants were given a contrast score ranging from 0-1. Linear regression shows that production and perception are significantly correlated ($p = <0.001$), with mean Euclidean distance between /ʊl/ and /ʌl/ tokens reliably predicting participants' contrast scores. This study is also the first to present evidence of merged and unmerged systems for /ʊl/ and /ʌl/ in both production and perception, as well as a new method for investigating vowel merger with pile-sort tasks.

Mentor(s): Abby Walker, English, Virginia Tech

Andres Lopez
Virginia Tech/International Studies

Formalizing Coronal Nasal-Obstruent Cluster Reduction in American English

Coronal nasal-obstruent flapping (/nt/ flapping) in American English (AE) is the process which renders words such as winter and winner as homophonous in the informal or rapid speech of most speakers (Garai 2021). What distinguishes this process from ordinary /t/ flapping in AE (ladder = latter) is the fact that this neutralization is optional, and surfaces variably: the same speaker may pronounce the same word with both variants. Moreover, some words containing intervocalic /nt/ tend to be flapped more often than others. For example, twenty is almost always pronounced with an /n/ as in [twɛni], whereas minty might be pronounced more often with an /nt/ as in [mɪnti]. This variation and the mechanisms underlying it are the primary focus of this study.

Via frequency rates of /nt/ flapping from the Buckeye Corpus, I investigate whether or not linguistic factors, such as morphological complexity and lexical frequency, play a role in whether or not an /nt/ sequence surfaces as an [n]. The variability observed in the corpus data is modeled using a MaxEnt Grammar (Goldwater & Johnson 2003), in order to predict the varying probabilities of flapping across different words. Preliminary generalized linear mixed effects modeling have shown that lexical frequency ($p = 0.009$) and following nasal segments ($p = 0.029$) have a significant effect on whether or not intervocalic /nt/ surfaces as [n]. In addition to reporting frequency rates of /nt/ flapping in corpus-drawn interview speech, an analysis of how various constraints may be influencing flapping rates within speakers is presented.

Mentor(s): Katie Carmichael, English, Virginia Tech

Radia Lu
Advanced Studies Blacksburg High School Student

Systematic Assessment of Large Language Model's Correctness and Biases for Minority Health

Large language models (LLMs) have begun permeating the medical sector and demonstrate immense potential for revolutionizing the clinical decision support system. These artificial intelligence programs are trained on vast sets of internet-based data including medical literature. However, women and people of color have historically been underrepresented in clinical trials and as a result, there is less medical literature highlighting health discrepancies surrounding minority health. My objective, therefore, is to test LLMs to determine if the lack of online minority health literature is reflected in the programs' responses.

To begin, established minority medical disparities in 5 pervasive diseases (type 2 diabetes, gout, heart disease, stroke, and clinical depression) were identified via a literature review. For each disease, inquiries were made and then inputted into 2 LLMs (Elicit and ChatGPT 3.5). Each question was asked 5 times for reproducibility and consistency.

The correctness of the LLMs responses were determined by using medical literature as a ground truth answer. When asked to explain an inaccurate phenomenon affecting minorities, ChatGPT 3.5 parroted back reasons supporting the baseless claims. In response to similar questions, Elicit used relevant articles to generate a response, but inaccurately analyzed the sources, often citing the opposite finding.

The novel results of my research indicate that LLMs are not yet equitable, as they fail to accurately address minority health concerns. LLMs must continue to be developed before they are used to diagnose and curate solutions in healthcare.

Mentor(s): Danfeng Yao, Computer Science, Virginia Tech

Thomas Lu
Virginia Tech/Computer Engineering

Robotic Histotripsy Systems for the Precise, Complete, and Non-invasive Ablation of Osteosarcoma Tumors

Osteosarcoma (OS), the most common primary bone tumor in humans and dogs, is a devastating disease. The current standard of care for appendicular OS involves limb amputation or salvage surgery with chemotherapy. These highly invasive procedures have failed to improve patient survival in the last 30 years. Histotripsy is the first non-invasive, non-ionizing, non-thermal ablation method that uses short, high-intensity focused ultrasound pulses to achieve precise mechanical disruption of cells. Recent studies have demonstrated the feasibility and safety of using histotripsy to treat appendicular OS in dogs. However, significant challenges remain before clinical translation. First, the clinical, FDA-approved histotripsy treatment system can only execute ellipsoidal volume treatments with uniform treatment dosing, but OS tumors are irregularly shaped and heterogeneous, containing both hard (mineralized) and soft tissues. Additionally, bony obstructions can severely limit targeting and treatment planning through ultrasound, which the clinical system relies upon.
To address these limitations, this study aims to develop novel histotripsy treatment and robotic targeting methods for fully ablating arbitrarily shaped, heterogeneous tumors. We have designed a new system that utilizes pre-treatment imaging (MRI, CT) to characterize tumor shape and composition, allowing for precise, patient-specific treatments with arbitrary volume/dosing schemes, even in the absence of clear ultrasound imaging. To implement and test this design, we have built a custom, robotically-guided histotripsy treatment platform for ex-vivo use. Ongoing studies are planned to experimentally validate the full ablation of OS tumors upon completion of the treatment approach, using a clinically-relevant ultrasound transducer to treat excised canine OS samples.

Mentor(s): Eli Vlaisavljevich, Biomedical Engineering and Mechanics (BEAM), Virginia Tech
Lauren Ruger, BEAM, Virginia Tech
Elliana Vickers, BEAM, Virginia Tech
Adam Maxwell, BEAM, Virginia Tech
Tim Hall, Biomedical Engineering, University of Michigan

Kalista Luzanta
Virginia Tech/Psychology
Kennetria Torain
Virginia Tech/Psychology
Angela Wilson
Virginia Tech/Neuroscience
Ashtyn Hall
Virginia Tech/Psychology

Supportive Factors for Language Learning in the Ecology of Toddlers

Much research has been done studying toddlers' word learning, primarily focusing on explicit experiences young children have in learning to name objects in referential contexts. Other experiences also have profound effects on language outcomes, including caregiving arrangements (in home v. center based), how much time toddlers are allowed to view screens (TVs, tablets, cell phones), and the influence of other adults and children in the home. Here, we also examine some of the common ecological factors that may support children in their everyday environments as they become more language proficient. We examined the relationships between expressive vocabulary size in 2-year-olds and their (1) day care experience, their (2) screen time experience, and (3) whether they have older siblings in their homes. We gathered this information from 31 24-mo-olds who were part of a larger longitudinal sample in the Multinet Study in the iLEAP Lab. Bivariate correlations showed a significant positive correlation between time in full-time daycare (in months) and MCDI W&S ($r=+.41$, $p=.05$), but no significant correlations between either educational screen time ($r=.17$, $p=.36$) or non-educational screen time ($r=.24$, $p=.19$) and this same measure. Likewise, there was no significant correlation between number of older siblings and MCDI W&S ($r=-.07$, $p=72$) although number of older siblings was significantly correlated with non-educational screen time ($+.64$, $p=.001$). Taken together, these results show an interesting, positive benefit of day care experience on expressive language skills that is not seen in screen time or in sibling presence.

Mentor(s): Robin Panneton, Psychology, Virginia Tech

Justin Lytle
Virginia Tech/Biological Systems Engineering

Linking access to private system water treatment, demographics, and water quality in southwest Virginia

Private drinking water supplies (e.g. household wells) are non-regulated drinking water systems that are typically concentrated in rural areas. Previous research suggests that water quality issues in these systems are common, but limited efforts to link these issues to homeowner sociodemographics renders the design of interventions difficult. This project represents a partnership with the Virginia Household Water Quality Program (VAHWQP), a Cooperative Extension program that provides inexpensive water quality testing and education to participants reliant on private water supplies in Virginia. The work aims to link household demographics to the presence of in-home treatments in homes dependent on private water supplies in Virginia. Sociodemographic data and at-home water quality data include: 792 water quality samples and 492 surveys detailing homeowner demographics collected between 2020-2024 from six counties in southwest Virginia. The most common observed water quality concerns associated with health-based standards in municipal supplies were lead, copper, E. coli, and coliform levels. Other contaminants of concern, associated with water aesthetics and EPA guidance levels, were aluminum, sodium, pH, iron, and manganese. The majority of homes either used no treatment prior to consumption (35% of participants) or treatment for water aesthetics only (43%; n=792). Household that reported lower income levels (<$52,000) were found to have the highest percentage of no treatment compared to higher income levels. This study suggests a need for deeper understanding of the links between demographic data, available treatment, and water quality observations, and will help form a framework for improving public health and rural water quality.

Mentor(s): Leigh-Anne Krometis, Biological Systems Engineering, Virginia Tech

Jessica Magee
Virginia Tech/Water: Resources, Policy, and Management

Tracking Antimicrobial Resistance in SWVA through Septage Surveillance

Antimicrobial Resistance (AMR) has become an increasingly prevalent human health hazard. While the causes and effects of this have been studied across many settings, there is a lack of knowledge in how wastewater surveillance can be used to study the spread of AMR through human populations and local environments, particularly in rural communities which are home to the nation's most severe health disparities. The goal of this study is to examine antibiotic resistance occurrence in septic tank systems versus centralized sewer systems in southwest Virginia (SWVA) and how occurrence differs according to local social and economic factors. Septic tank sludge (septage) pump out and influent centralized sewage samples were collected from a local wastewater treatment plant (WWTP) bimonthly for a year (n= 52 septage samples; n= 26 influent sewage samples) and filtered to capture bacterial DNA. Following DNA extractions, qPCR was used to enumerate gene copies of both 16S rRNA and sul1 (encoding for sulfonamide resistance) an indicator gene for the presence of AMR. Preliminary results suggest that absolute counts of sul1 are slightly higher in septage samples compared to WWTP influent, but also are significantly more variable. However, measures of total bacteria (16SrRNA) are also higher for septage, which leads to lower 16S-normalized abundances across samples. Overall, early indications seem to point towards significant AMR detection within rural septic tanks. Further research is needed to examine whether septic systems facilitate antibiotic resistant gene (ARG) transfer and direct connections to adverse health impacts in rural communities.

Mentor(s): Leigh Anne Krometis, Biological Systems Engineering, Virginia Tech
Sarah Price, Biological Systems Engineering, PhD student, Virginia Tech

Maggie Maguire
Virginia Tech/Human Nutrition, Foods, and Exercise

The Variability in Energy Expenditure Among Female Soccer Players

Total energy expenditure (TEE) is difficult to evaluate in elite female athletes. PURPOSE: This study investigated the variability in TEE in female field soccer players. METHODS: TEE was calculated during a 3-day period (2 training days and 1 match day) in eleven collegiate division I female soccer players (age = 19.5±1.4 yrs, weight = 67±8.7 kg, lean body mass= 48.6±5.5 kg) during the spring season using the factorial method. Indirect calorimetry (Parvo Medics) was used to measure resting metabolic rate (RMR). RMR was multiplied by an activity factor of 1.2 assuming athletes were sedentary outside of training. Detailed food records were collected to estimate energy intake (EI). Thermic effect of food (TEF) was calculated from 10% of EI. Energy cost of exercise was measured using GPS devices (Stat Sport Apex). The following equation was utilized for each of the 3 days to analyze the participants' TEE: (RMR x 1.2) + 10% EI - EE. RESULTS: The TEE averaged 2607 kcals over the 3 days (range =2495 kcals to 2751 kcals), was highest on the match day (2751±241 kcals; $p<0.001$ vs. training day 1 and training day 2), and was also significantly different between the two training days (day 1= 2577±201 kcals and day 2= 2495±198 kcals; p= 0.04). CONCLUSION: Based upon previous studies, the data falls within the expected range for professional female soccer players, showcasing the day to day variability in TEE.

Mentor(s): Enette Larson-Meyer, Human Nutrition, Foods, and Exercise, Virginia Tech Bradley Horton, Human Nutrition, Foods, and Exercise, Virginia Tech

Connor Maguire
Virginia Tech/Polymer Chemistry
Caroline Young
Virginia Tech/Cognitive and Behavioral Neuroscience
Alex Villa
Virginia Tech/Biology
Kayla Wilf
Virginia Tech/Chemistry

Impacts of the Mountain Valley Pipeline

Water quality can be impacted by a variety of environmental factors, which includes manmade interventions. In Blacksburg, VA, the water quality of several locations has been affected by the runoff of a new manmade intervention, the Mountain Valley Pipeline. The goal of this research project was to ascertain the effect of the Mountain Valley Pipeline on the quality of adjacent water features, namely by examining water metrics. We used the YSI Professional Plus Instruments probe at specific locations along the pipeline (e.g., nearby rivers and brooks) to determine measurements of turbidity, pH, temperature, conductivity, and dissolved oxygen content. Three replicates of measurements were taken above and below the pipeline over three separate locations. The turbidity, acidity, and dissolved oxygen of the water features across the pipeline showed no verifiable trends. However, there was an overall increase of water temperature and conductivity downstream of the pipe. This implies the pipeline affects water quality by increasing the salt content and temperature. To further understand the effects of the Mountain Valley Pipeline on nearby water sources, other locations across the pipeline could be measured in addition to additional water quality measurements.

Mentor(s): Temperance Rowell, Science, Virginia Tech

Minahil Malik
Virginia Tech/Computer Science
Ananya Seth
Virginia Tech/Computer Science
Rishab Desai
Virginia Tech/Computational Modeling and Data Analytics
Rohan Ilapuram
Virginia Tech/Computational Modeling and Data Analytics

Analysis of Student Perceptions of Teaching Reports with Natural Language Processing

This project aims to create a system using Natural Language Processing models to evaluate student free response questions. This would provide professors with valuable feedback from end of semester survey questions by identifying common themes in student responses, since it is currently unrealistic for professors to read through large volumes of student survey responses.
To run our analysis, we first input and clean the data and run initial embedding on the data to find similarities between words and phrases. We then run dimension analysis using Principal Component Analysis (PCA) to reduce the amount of data into the data that is most descriptive of the whole. Then, we use agglomerative clustering to find similar groupings in the data and use sentiment analysis to assign positive, negative, and neutral scores to the data. We plot the data to see how different clusters relate to each other and which clusters have overwhelmingly positive or negative responses.
This semester we have been working on creating our system for professors based off interviews with professors to see what they want to include. We found that faculty were interested in features such as comparing feedback within their department and the university and filtering based off positive, negative, and neutral responses. We created wireframes using Figma and used React for an initial front-end system and are combining it with a previously developed backend system in Python. We will continue to test our tool with professors we interviewed to make sure we are helping our targeted audience.

Mentor(s): David Gray, Engineering Education, Virginia Tech

Varsha Manickam
Virginia Tech/Data-Centric Computing
Siddharth Rakshit
Virginia Tech/CMDA

Visualizing Climate Change: From Ice Caps to Coral Reefs

Climate change, with its profound and multifaceted impacts, is increasingly being recognized as an urgent issue. While there is an abundance of data on climate change causes and consequences, accessing this data is often confounded in part by the complex multi-dimensional data structures that necessitate many distinct data science skills to work with the data. Our study attempts to bridge this gap between scientific research and public understanding via generally accessible dashboards and data visualization tools. Our approach is two-pronged - one perspective focuses on ice cap melting, a geological change caused by global warming whereas the other perspective focuses on the ecological effects of climate change through coral reef bleaching. Utilizing geospatial analysis, interactive visualizations, and machine learning, we identify trends and simplify data, striving to present this critical information in an engaging and intelligible manner. Our goal is to transform complex data into clear visual narratives, thus enhancing public awareness and facilitating engagement with the climate change discourse. We believe we can accurately model sea ice levels due to multiple factors such as global temperature increases and produce comprehendible visualizations of coral reef health. The nonexpert struggles to understand the impacts of climate change often due to the complex and multi-dimensional nature of the data. Future directions include performing more outreach and presenting our work in different events to foster deeper public understanding of the effects of climate change and gauge perceptions on the urgency of climate change and its impacts to inform future dashboards.

Mentor(s): Anne Brown, University Libraries, Virginia Tech

Lindsey Mann
Virginia Tech/Biochemistry
Stephanie Levy
Virginia Tech/Biochemistry

Analyzing Binding Patterns of Ceftriaxone and Cefepime in the β-lactamase Active Site

Modern day bacteria are becoming increasingly resistant to antibiotics, a large class of which have a β-lactam ring. β-lactamase is a common enzyme that is produced by bacteria to break down β-lactams. Their main cause of resistance stems from the bacteria mutating and developing a resistance to β-lactam antibiotics. This creates a want to find other ways to work around their resistance, one specific way would be to change the ligand of the β-lactamase and therefore affect its binding affinity. By assessing ligands of similar chemical structure, we sought to inhibit β-lactam by comparing inhibitors. Changing the ligand from ceftriaxone to cefepime, which has a side chain substitution and faster wall penetration abilities, led to the observation that the new ligand cefepime had a greater binding affinity. Redocking was first performed to first confirm ceftriaxone's original position and observe the ligand's binding affinities to β-lactamase. After observations regarding the original ligand's position were recorded, molecular docking methods were used to dock the new ligand, cefepime, providing new data for bonding affinities and positions for which the ligand fits within β-lactamase. The hypothesis predicted that there would be lower binding affinity with cefepime, which was proven correct via the data and observations. This showed that there was a more negative binding affinity when the ligand was switched, changing from -9.399 to -10.808. Lower binding affinity means that there is less binding to break the β-lactam ring in β-lactamase and has higher efficacy against antibiotic resistant microbes.

Mentor(s): Anne Brown, University Libraries, Virginia Tech
Truitt Elliott, Biochemistry, Virginia Tech
Anthony Briganti, Biochemistry, Virginia Tech

Jeremy Mann
Virginia Tech/Chemical Engineering

Processing of Melt-Blended Ternary Polymer-Clay Composites for Additive Manufacturing

Current air-based contaminant capture techniques make use of packed beds with adsorbents of simple geometries; however, these mechanisms suffer from high pressure drop, particle attrition, and a failure to maximize exposed surface area. By creating novel composites with high surface area geometries, we aim to improve current packed bed methods for carbon capture. We have developed a novel 3D printable polymer/clay composite of Poly(lactic acid) (PLA), bentonite, and zeolite to be used for contaminant removal applications.

We hypothesize that by utilizing both filler particle systems we will achieve a filament with well exfoliated and dispersed clay particles while maximizing zeolite's affinity for a desired adsorbant (in this case, CO_2). Shaping, Debinding, and Sintering (SDS) post processing will maximize the surface area ratio available for contaminant capture. To apply such methods, the loading percentage of the clays must be high enough to form bridgeable connections, the polymer must burn off clean, and the thermal stability difference between the clays and polymer must be different enough to avoid self-sintering.

We perform thermo-mechanical analysis to assess the stiffness of our clay composites for SDS, followed by sintering the printed material into high surface area geometries. Based on the outcome of the testing and sintering, we iteratively adjust composition and/or process parameters until successful morphology is realized. Ultimately, we aim to explore the exfoliation threshold required for successful SDS to be performed with our composite. We expect that reaching this threshold will greatly enhance the mechanical properties of our sintered parts while increasing the surface area ratio, resulting in substantial improvements to current packed bed methods for carbon capture.

Mentor(s): Michael Bortner, Department of Chemical Engineering, Virginia Tech

Caroline Maso
Virginia Tech/Political Science

Evolutionary Ethics - Analyzing morality through the lens of natural selection

This study investigates the evolutionary roots of moral behaviors in organisms, seeking to answer the central question: Why does evolution select for moral tendencies? The purpose of this study is to challenge the historical belief that morality cannot be explained by science. Morality often seems to require setting aside one's own interests for the sake of ideals like fairness or the common good. It is puzzling how evolution by natural selection - a process often described as "survival of the fittest" - could produce beings that are "moral" in this way. The methods utilized for this study involved analyzing molecular evolution mechanisms like genetic variation, mutations, heritability, and natural selection. Additionally, two main classifications of altruistic behavior - kin altruism and reciprocal altruism - were examined through the lens of their underlying genetic drivers. An extensive review of scholarly works on evolutionary ethics informed the analysis. The results of this study demonstrate how the emergence and persistence of altruistic tendencies can be accounted for by evolutionary processes selecting traits that increase an organism's chances of passing along its genes, even at an individual cost. Kin altruism promotes self-sacrificing for genetic relatives, while reciprocal altruism incentivizes cooperation with the expectation of future reciprocation. Ultimately, this research provides an evolutionary explanation for the development of moral inclinations, reshaping the traditional philosophical separation between empirical science and normative ethics.

Mentor(s): Justin Hron, Philosophy, Virginia Tech

Dina Masri
Virginia Tech/Psychology

Effects of Describing Sexual Assault, Harassment, and Sexism on Women's Employment Interview Outcomes

This research investigates the impacts of negative workplace incidents experienced by women, including sexual assault, sexual harassment, harassment, and sexism, on their interview outcomes. Specifically, participants completed a six-question mock employment interview, and the question that asked about uncomfortable or difficult situations at work elicited responses describing such negative events from some female participants. First, two researchers reviewed all responses to that question and determined whether the responses detailed experiences of sexual assault, sexual harassment, harassment, and/or sexism. Second, we analyzed how describing these incidents affected interviewer ratings of interviewee Big Five traits, intelligence, and hireability. Our findings suggest that describing such incidents leads to lower interview evaluations. In particular, interviewees who described such incidents were rated lower in agreeableness and openness compared to other women, and they were rated lower in emotional stability and openness but higher in conscientiousness and extraversion compared to all other interviewees. This offers significant insights into the nuanced ways in which workplace harassment affects essential aspects of employability and personality expression, highlighting the broader implications for organizational practices, hiring processes, and workplace equity. In the future, employment interviews should undergo sensitivity analyses to remove questions that may elicit such responses. Even if women who experienced such incidents do not describe them in the interview, such questions may activate those memories and negatively impact their interview performance.

Mentor(s): Louis Hickman, Psychology, Virginia Tech

Erika Mathov
Virginia Tech/Biological Sciences

Evidence of Arboviral Circulation in Swanson, New York via Serosurveillance in Wildlife

Arboviral diseases are becoming increasingly prevalent in the Eastern U.S. Therefore, a better understanding of their geographical distribution and wildlife exposure rates is necessary. One way to expand our knowledge of these factors is by surveilling surrounding wildlife. Blood samples from various types of animals have been collected by a wildlife rehabilitation center in Swanson, NY. These blood serum samples can be used to perform plaque reduction neutralization tests (PRNT), which will allow for the determination of antibody presence. Arboviral diseases that are becoming more widespread include Bourbon Virus, Heartland Virus, La Crosse Virus, St. Louis Encephalitis Virus, Powassan Virus, and West Nile Virus. Each serum sample will be separately exposed to the listed viruses during a PRNT assay. Once the test is complete, any evidence of antibodies for the disease can be identified. This will allow for a better understanding of the prevalence of each disease in various types of wildlife and how they are geographically distributed.

Mentor(s): Gillian Eastwood, Entomology, Virginia Tech

Lee Matthew
Virginia Tech/Biology

Effects of passive warming on pollinator visitation in mayapple (Podophyllum peltatum)

A notable gap remains in our understanding for how warming temperatures due to climate change will impact species interactions. Warming temperatures have the potential to disrupt pollination both chemically and phenologically, consequently affecting the activity of pollinators. In this study, we used field-based passive warming chambers alongside ambient chamberless controls to investigate the effects of warming on insect-mediated pollination in Podophyllum peltatum, an herbaceous spring ephemeral wildflower found in understory environments. We recorded pollinator visits with wildlife cameras. These data were paired with temperature data we collected with iButton temperature loggers. We found a significant difference in pollinator visitation rates, with plants in warming chambers receiving fewer visits compared to those in ambient conditions. Additionally, plants in the ambient chamberless controls developed fleshy fruits, but those in the warmed treatment failed to do so. Reduced pollinator visits observed in the passive warming chambers may be attributed to a negative effect of warming on insect pollinator activity, however, it may also be possible that our passive warming chambers were simply unintentionally preventing insect pollinator access to plants Moving forward, it is important for future studies to include chamberless controls when using passive warming designs so that effects of temperature and chamber accessibility can be separated.

Mentor(s): Susan Whitehead, Biological Sciences, Virginia Tech
Melissa Burt, Biological Sciences, Virginia Tech,

Emily McAlpin
Virginia Tech/Nanomedicine

Antagonism of the Insulin Receptor Preserves Density in Hyperinsulinemia in Cardiomyocytes

Type II diabetes (TIID) is currently on the rise and has devasting consequences for many organ systems. Notably, patients with diabetes are at least twice as likely to develop cardiovascular disease and heart failure, independent of additional risk factors. Such dysfunction is termed 'diabetic cardiomyopathy.' However, current therapies for TIID remain limited in their efficacy. TIID often occurs as a result of chronic overnutrition and the pancreatic secretion of excess insulin to enhance nutrient uptake, utilization, and storage by insulin-sensitive tissues, such as the heart. During this sustained hyperinsulinemia, the insulin receptors (IRs) desensitize, internalize, and downregulate to prevent their overstimulation and the overactivity of their downstream cellular pathways. We hypothesized that inhibition of the IRs using a peptide agonist, S961, would prevent hyperinsulinemia-induced reductions in receptor activity and levels in cardiomyocytes. Utilizing neonatal rat ventricular cardiomyocytes (NRVMs), we found that 24h treatment of 100nM insulin, which is an established model of insulin resistance, decreased the expression of the IR-β and IR-α. We optimized dosage of S961 in NRVMs to confirm a lack of activation of the receptor. We then inhibited the IR using 10nM and 100nM doses S961, followed by 24h 100nM insulin, which resulted in partial rescue of the IR expression as compared to insulin treatment alone. These data present receptor agonism as a promising therapeutic avenue in re-sensitizing IRs to the effects of insulin, and restoring the critical downstream signaling mediated by physiological insulin.

Mentor(s): Jessica Pfleger, Biological Sciences, Virginia Tech

Zachary McCarel
Virginia Tech/Biological Sciences

Exploring candidate genes involved in terpene pheromone biosynthesis in the American cockroach, Periplaneta americana

American cockroach, Periplaneta americana, females release a sex pheromone blend that contains the terpenoid, periplanone B. However, the biosynthetic origins of terpenes in this species and many other terpene-releasing insects remain uncharacterized. While genes for canonical terpene synthase (TPS) enzymes as known in plants and microbes are not found in insect genomes, recent research has highlighted that some insects can produce terpenes via the action of isoprenyl diphosphate synthase (IDS) enzymes that have convergently evolved TPS function. Here we explored P. americana genomic and transcriptomic resources to identify candidate genes for IDS-derived TPSs involved in P. americana terpene pheromone biosynthesis. We employed BLAST searches and the pairwise alignment tool, Exonerate, to mine for IDS-like genes in transcriptomes and the genome of P. americana. Using the sequences we obtained, we compared residue substitutions in catalytic motifs using multiple sequence alignments, inferred phylogenies with other insect enzymes that have known IDS or TPS function, and compared male and female expression levels in silico to narrow down TPS candidates. Several TPS candidate genes were identified, and further research is needed to verify TPS enzyme function in the encoded proteins of candidate genes.

Mentor(s): Dorothea Tholl, Biological Sciences, Virginia Tech
Zarley Rebholz, Biological Sciences, Virginia Tech

Isaac McGinniss
Virginia Tech/Biochemistry

Exploring the Correlation between Canine Health Factors, Supplement Usage, and Owner Perceptions: Insights from the Dog Aging Project

This study investigates the relationship between various health factors, supplement usage, and the overall health status of dogs. Understanding these correlations can provide valuable insights for pet owners and veterinarians in optimizing canine health and wellness. The aim of this research was to identify any significant correlations between dog lifestyle factors (such as activity level, frequency of veterinary visits, and overall health of the dog as assessed by their owner) and the use of supplements, including joint supplements, antioxidants, and other nutritional supplements. Data was collected through surveys administered to dog owners participating in the Dog Aging Project, a long-term, longitudinal project. Surveys captured information on dog participants such as their breed, activity level, frequency of veterinary visits, owner-reported health assessments, and supplements given to their pets. Correlation analysis was conducted using Excel, exploring relationships between variables. Initial findings suggest correlations between certain supplement usage patterns and reported health status by owners. Most dogs categorized as being in Very Poor, Poor, Fair, and Good Health received supplements. In contrast, a significant percentage of dogs categorized as being in Very Good or Excellent Health did not receive supplements, indicating a trend where owners who perceive their dogs as already healthy tend not to use supplements. This trend may suggest that owners administer supplements to dogs they perceive as needing health improvement. These findings underscore the importance of tailored supplement regimens for canine health maintenance. Further research could explore causal relationships and the effectiveness of specific supplements in improving overall canine health.

Mentor(s): Audrey Ruple, Population Health Sciences, Virginia Tech

Juliana McIrvin
Virginia Tech/Mechanical Engineering

Low Level Control Methods for 3D-printed Quadruped Robot

Squeaky 2.0 is an upgraded open source 3D-printed quadruped robot for research and educational purposes. While the 3D-printed chassis and leg structures drastically reduce the cost of Squeaky 2.0, the compliance and reduced strength of 3D-printed parts provide unique challenges for control of the quadruped. In this work, we develop the low level control methods to actuate the 12 degree of freedom robot with brushless DC motors. The primary control method is a position-based PD control loop with feed-forward torque control and is used to generate simple actions including standing, walking, and crouching. The low level control is implemented using a Teensy 4.0 coupled with embedded current, position, and velocity encoders in the 12 motors. Future work will include integrating a NVIDIA Jetson Nano to run more complex high level control methods such as path planning and computer vision.

Mentor(s): Alexander Leonessa, Mechanical Engineering, Virginia Tech

Charlotte Menke
Virginia Tech/Human Development
Lillian Zaccaria
Virginia Tech/Human Development

The Role of Parent Emotion Regulation, Parent Emotion Expressivity, and Child Emotion Regulation in Parent-Child Dyadic Conflict

High mother-child conflict has been associated with adolescent depressive and anxiety symptoms (Giessen et al., 2014). In a conflict discussion task with school-aged children, more self-reported maternal emotion dysregulation was associated with more child emotion dysregulation (Morelen et al., 2016), and partners were found to match negative emotions expressed by the other during conflict (Main et al., 2016). Therefore, research needs to examine emotionality and regulation in both dyad members (mothers and children) as they relate to dyadic conflict. Using longitudinal data, our proposed model examines mechanisms contributing to dyadic conflict, including maternal-reported emotion regulation strategies, observed maternal emotional expressivity, and observed child emotion regulation. We propose that the relation between maternal emotion regulation and dyadic conflict would be mediated by maternal affect. The relation between maternal affect and dyadic conflict is hypothesized to be moderated by child emotion regulation.
Using a moderated mediation model, we examined these relations across 2 time points (preschool, T1; school-aged, T2). At T1, 116 mother-child dyads participated (62 boys), and 95 [CLS1] dyads returned at T2 (50 boys). At T1, mothers reported on their emotion regulation, and maternal positive and negative affect was observed in a freeplay. At T2, child emotion regulation was assessed in a frustration task, and dyadic conflict was observed in a structured teaching task. Findings from our moderated mediation model will have implications for parenting programs to reduce dyadic conflict. Identifying specific emotion-related pathways that contribute to dyadic conflict can help to develop intervention programs to reduce highly conflictual relationships.

Mentor(s): Cindy Smith, Human Development, Virginia Tech
Meredith Atanasio, Human Development, Virginia Tech

Marya Miller
Virginia Tech/Animal and Poultry Sciences

Effects of Butyric Acid on Broiler Intestinal Health

The removal or limitation of antibiotics from commercial poultry production opens opportunities for feed additives to promote poultry health and performance. Therefore, an experiment was conducted to evaluate the effects of various concentrations of a coated butyric acid (BA) on growth performance, ileal energy and dry matter digestibility, and oocyst shedding of 42-day-old male Ross 708 broilers raised on used litter without antibiotics. Used litter was generated by housing 30 chicks vaccinated with CocciVac® B52. A second flock of experimental birds was split into 12 replicate pens of 35 birds for each of the six treatments (PC with clean litter and no dietary treatment, NC with used litter and no dietary treatments and 4 treatments with used litter and various concentrations of BA fed via the diet). Body weight gain (BWG), and feed conversion ratio (FCR) were calculated over 0 to 10, 0 to 28 and 0 to 42 d periods. Ileal contents were collected on 14 d to determine nutrient digestibility. Fresh excreta samples were collected for oocyst shedding determination. From 0 to 10 d, the NC birds resulted in reduced BWG. However, this difference was lost over later time periods. Butyric acid was able to improve FCR over the 0 to 10 d period but again performance differences were lost after the first period. Broilers supplemented with BA resulted in improved apparent ileal digestible energy and dry matter compared to the PC and NC birds. Oocyst shedding peaked at 11 to 13 d and declined to almost zero by 22 to 24 d. Overall, butyric acid was able to ameliorate the negative effects with the reused litter model during the 0 to 10 d period and improved dietary digestibility of broilers.

Mentor(s): Michael Persia, Animal Science, Virginia Tech

Candace Miller
Virginia Tech/Biochemistry

Characterizing the Electronic Impact of Phosphorylation on GSXS Tetrapeptides

Post-translational modification (PTM) refers to the chemical modification of a polypeptide or protein to modulate its structure, function, stability, an subcellular localization. Phosphorylation is one of the most common PTMs and frequently occurs on serine, threonine, and tyrosine. The addition of the negatively charged phosphate group to the previously neutral side chains also affects the electronic properties of of the nearby amino acids and may ultimately explain the alterations in the protein's structure and potentially function. Therefore, molecular dynamics (MD) simulations with a polarizable force field (FF) can best provide atomistic insight into the behavior of phosphorylated protein systems. Here, recently developed parameters for phosphorylated amino acids with the Drude polarizable FF were validated using GSXS, where X is serine, threonine, or tyrosine. Unbiased MD simulations of both nonphosphoryated and phosphorylated states of each system were carried out. We calculated JHNHα-coupling values to compare to experimental data and studied the shifts in electronic properties caused by phosphorylation through the calculation of peptide-bond dipole moments and changes in the electric fields surrounding the phosphorylation sites. These validated parameters can be used to understand the role that phosphorylation-dependent shifts in electronic properties have on protein dynamics, and ultimately, alterations in protein structure and function.

Mentor(s): Justin Lemkul, Biochemistry, Virginia Tech

Tyler Moore
Virginia Tech/Biochemistry

Histotripsy: Using Focused Ultrasound to Diagnose, Target, and Treat Pancreatic Cancer

Despite only comprising 3% of all cancer diagnoses, pancreatic cancer is responsible for 7% of all cancer deaths due to the inability to detect cancer development until stage IV or metastasis.
Current techniques for treating cancers include radiation, surgical, and thermal treatments which each have well-known side effects that can hinder the recovery of a patient. Histotripsy is a novel cancer therapeutic technique that uses focused ultrasound to mechanically ablate (damage) tumorous regions. As a non-invasive, non-thermal, and non-ionizing approach to treating cancerous areas within tissues, histotripsy excels at high precision targeting and lacks the notorious side effects that arise with current cancer therapeutics. Our aim is to identify immunological responses to focused ultrasound within physiological conditions. Current in vitro studies involve the quantification of cell ablation and proliferation at and after the time of treatment. We are additionally working to optimize ultrasound transducer parameters to achieve 50% and 100% ablation within our treated cell cultures. Our studies show various increases in cellular response to these treatments, and we look to see how this can help our knowledge of future human clinical trials. Understanding patterns and cell responses is a crucial and fundamental step in learning how histotripsy could better our current strategies to boost the devastatingly low survival rate.

Mentor(s): Coy Allen, Biomedical Sciences, Virginia Tech
Eli Vlaisavljevich, Biomedical Engineering, Virginia Tech

Trevor Moore
Virginia Tech/Wildlife Conservation
Caroline Gerling
Virginia Tech/Wildlife Conservation
Evan Roberts
Virginia Tech/Wildlife Conservation

Disappearing Voles-Does Least Weasel Presence Decrease Vole Observations in Mostela Boxes?

Least weasels (Mustela nivalis) are the world's smallest carnivores. Due to their elusiveness, little is known about their life history and ecology, especially in Virginia. Due to their high caloric demands, least weasels are thought to frequently change feeding areas after they reduce prey densities. We pioneered the use of a new sampling technique, the Mostela box, in the United States which uses cameras to study the least weasels. From 2020–2024, we document the least weasels on the Virginia Tech campus. Additionally, we also documented encounters with their main prey species, Meadow Voles (Microtus pennsylvanicus) and mice (Peromyscus sp.). We compared prey numbers before and after the least weasel was observed in our boxes. Meadow Voles numbers greatly decreased after the least weasel appeared, but mice numbers did not. However, if voles were not observed in boxes prior to the least weasels, mice numbers decreased after the least weasels appeared. Our results suggest that least weasels are preying on meadow voles if they are present, and prey on mice in the absence of voles.

Mentor(s): Kevin Hamed, College of Natural Resources and Environment, Virginia Tech
Austin Holloway, College of Natural Resources and Environment: Department of Forestry M.S., Virginia Tech
Mark Ford, College of Natural Resources: U.S.G.S, Virginia Tech

Siena Morlatt
Virginia Tech/Biochemistry

Computer-Aided Drug Design for HIV-1 by Exploiting Differences in LTR-III G-Quadruplex Conformations

Human Immunodeficiency Virus-1 impacts 1.2 million people in the United States. If left untreated, the disease destroys the body's immune system, resulting in Acquired Immunodeficiency Syndrome (AIDS). Once the viral genome is reverse-transcribed and integrated into the host, HIV-1 gene expression is controlled by the long terminal repeat (LTR) region, which can form two dynamic G-quadruplex (GQ) structures. The major LTR GQ, known as LTR-III, downregulates viral gene expression when formed. LTR-III demonstrates a distinct folding topology containing a 12-nucleotide duplex loop with a dynamic quadruplex-duplex junction (QDJ). Previous molecular dynamics simulations characterized the dynamics of Ade4:Thy14 and Gua3:Thy14 base pair interconversion in the QDJ junction, with states separated by only small free energy barriers. Targeting the different LTR-III conformations with small molecules to stabilize the GQ structure is a new avenue toward rational drug design. Using Site Identification by Ligand Competitive Saturation (SILCS), we mapped the occupancy of functional group solutes to the Ade4:Thy14 and Gua3:Thy14 base-paired conformations of the LTR-III GQ. We compared nonpolarizable (CHARMM) and polarizable (Drude) force fields to determine the impact of electronic polarization on DNA-solute interactions. Drude occupancy maps suggest more favorable solute interactions than the additive force field. Hydrogen bond donor and acceptor occupancies are more pronounced on the face of the closed duplex in the Ade4:Thy14 and Gua3:Thy14 conformations, whereas apolar occupancies are elevated at the junction of the open conformation, which has no base pairs among Gua3, Ade4, and Thy14. Further research into dynamic structures formed by LTR-III will be used to advance novel HIV-1 drug design.

Mentor(s): Justin Lemkul, Biochemistry, Virginia Tech
Haley Michel, Department of Biochemistry, Virginia Tech

Lilianna Morris
Virginia Tech/Biochemistry

Assessing predictability of community reintegration for inmates upon release

Signed into law in 2018, the First Step Act required the Bureau of Prisons (BOP) to develop and systematically employ risk and needs assessments for inmates which are currently used to classify their risk of recidivism and identify individual criminogenic needs that must be addressed to prepare them for a successful reentry into their communities upon release. The risk assessment is a questionnaire completed periodically with prison staff while the needs assessment is evaluated through self-reported surveys, professional meetings, and an inmate's criminal history. The results of the inmate's needs assessment are used to provide Evidence-Based Recidivism Reduction (EBRR) program suggestions specific to the inmate's needs. Inmates' risk and needs are reassessed no less than once a year to ensure they are on track to develop or maintain a "low" or "minimum" recidivism risk rating. At the end of inmates' sentencing periods, they are typically released to Residential Reentry Centers (RRCs), also known as prerelease custody, where reentry programming continues with offenders experiencing varying degrees of restriction. This study aims to analyze the trends between individuals who have completed EBRR programming tailored towards select criminogenic needs and their success in RRCs. The goal is to use these analyses to determine if these trends can be used to predict the success outcomes of individuals who participate in EBRRs in the future.

Mentor(s): Nikki Lewis, Honors College, Virginia Tech

Katelyn Morris
Virginia Tech/Cognitive and Behavioral Neuroscience
Chris Odom
Virginia Tech/Clinical Neuroscience

The Impact of Voice Assistant Accent on User Experience

Voice assistants (VAs), such as Siri and Alexa, are increasingly relied upon for human-device interaction. However, the default female-sounding and mainstream-accented voices may not appeal universally. Research suggests that matching user and VA dialects could impact performance, as seen when bilingual speakers excelled in driving simulations with directions in their first language (Muhundan & Jeon, 2021). Additionally, listeners bring dialect stereotypes to their perception of VAs, with speakers of marginalized dialects appreciating hearing themselves represented in voice assistants (Holliday, 2023).

This study investigates the impact of VA accent on user experience. We compared Southern (SUSE) and Mainstream US English (MUSE) accented VAs among Southern and non-Southern US listeners. VA voices were generated in two ways: two generated through text-to-speech (TTS) technology, and another recorded by an actress performing a Southern and non-Southern accent. Participants engage in a user-testing scenario with both VA accents, involving calibration tasks, memory games, and trivia questions. Throughout the experiment, they rate their subjective experience and opinion on the VA, and at the end, they compare the two VA systems.

Results indicate a preference for the MUSE-accented VA among non-Southern participants, reflected in more positive scores and a higher selection rate in forced-choice scenarios. There are also hints of non-subjective effects, with SUSE-accented VA answers to unknown trivia rated as less true. These findings align with previous research on VA responses (Lev-Ari & Keysar, 2010; Snyder et al., 2023). Ongoing data collection promises further insights into how VA accent shapes user experiences, trust, and potential subjective biases.

Mentor(s): Abby Walker, English, Virginia Tech

Rachel Morse
Virginia Tech/Wildlife Conservation

Won't You Be My Neighbor? Estimating Ocelot Space-Use via Camera Traps in Belize

Understanding patterns of space-use and movement of wildlife species can inform protected land allocation and other conservation needs. Camera trapping may be a noninvasive and less-expensive method of studying animal movement compared to radio/GPS telemetry. We examined space-use patterns of ocelots (Leopardus pardalis), from remote camera data collected in Belize, Central America, during 2016 and 2017. We modeled individual Areas of Use (AoU), using a novel application of spatial capture-recapture (SCR). We used beta regressions to examine differences in AoU overlap proportions and potential influences of sex, year, interactions, and individual heterogeneity. Means and medians were similar for both sexes across years, with larger differences in variance in males between 2016 and 2017 (sd:15.83, 12.51 km2 respectively). Females exhibited comparable mean AoU overlap with both males (0.44-0.38) and other females (0.42-0.44). Males had higher mean AoU overlap with females than with other males in 2016 (0.67, 0.35 respectively) compared to 2017 (0.39, 0.27), which could be reflective of overall differences in variation between years. Beta values of the top model indicated that while most ocelots had significant AoU overlap (72.7%) with others, sex-specific differences showed smaller overlap. We did not observe anticipated differences in AoUs or overlap between sexes, possibly due to limitations in spatial redetections from our collected data. Nevertheless, our approach yielded estimates for individuals with few detections. This method holds promise for future space-use estimation, which could be used to better inform conservation efforts in Belize and serve as a model for similar camera trapping studies.

Mentor(s): Marcella Kelly, Department of Fish and Wildlife Conservation, Virginia Tech
Robert B. Nipko, Department of Fish and Wildlife Conservation, Virginia Tech

Rachel Morse
Virginia Tech/Wildlife Conservation
RJ Foster
Virginia Tech/Wildlife Conservation

Documenting Bird Mortality from Window Collisions on the Virginia Tech Campus

Window collisions are one of the leading anthropogenic causes of avian mortality, with estimates ranging from 365 million to 1 billion deaths annually. Birds often collide when they see patches of sky or foraging cover depicted in reflective glass. We aimed to understand the nature of bird-window collisions on the campus of Virginia Tech with respect to timing, age of birds, frequency, and location. Over the course of the 2019-2021 fall semesters, we surveyed 48 buildings 1-3 times a week; surveys consisted of walking the perimeter of a building and looking for evidence in the form of carcasses, feathers, or dust imprints on windows. We identified five collision hotspots on campus within which >60% of our successful surveys occurred. These areas along with a few minimal collision buildings have become the main focus of our investigations into this issue during the Fall 2022 and 2023 semesters. Since the start of the study, we have documented the deaths of 57 species of birds and found evidence of collisions on 29% of surveys (n= 1486), with the majority of collisions occurring at northwest (315) to northeast (30) facing windows. By identifying and continuing to monitor areas of greatest concern, we plan to offer the university informed guidance on where it can mitigate bird-window collisions.

Mentor(s): Kevin Hamed, Department of Fish and Wildlife Conservation, Virginia Tech

Isabel Motil
Virginia Tech/Psychology

Perceiving Emotions Under Stress and Gratitude Conditions: Impact of Gratitude on Perceiving Positivity

From a police officer de-escalating a situation to a mother talking to her own children, interpreting the facial expressions of others is a necessary part of properly communicating with other people. This study had two parts, with the first focusing on the effect of stress on the accuracy of perceiving emotions and the second focusing on the effect of gratitude on the perceived affect of photographed faces. In the first study, participants completed an online questionnaire requiring them to correctly identify emotions on CGI faces while under the effect of a stressor. They were assigned to one of four groups: Time Constraint (n=12), Authority Figure (n=15), Time/Authority (n=11), and Control (n=10). However, no significant between-group differences were found.
Due to this, researchers decided to restructure the experiment in Part 2 of the study, focusing on how gratitude priming affected how one perceives faces. In Part 2, participants were assigned to one of two groups: Gratitude (n=13) and Control (n=16). All participants completed a writing exercise, followed by an emotional perception test. Gratitude participants reflected on something they were grateful for within the past week, and Control participants wrote about their most recent meal. For 5 of the 20 faces (3 neutral, 1 sad, and 1 angry), researchers found significant differences between groups, where the Gratitude group perceived the faces as significantly more positive or less negative than the Control group.

Mentor(s): E. Scott Geller, Psychology, Virginia Tech
Jack Wardale - Department of Psychology, Virginia Tech

Elizabeth Mowry
Virginia Tech/Environmental Conservation and Society

The Accessibility of Environmental Research: Addressing Challenges and Strategies for Inclusive Fieldwork

According to the Centers for Disease Control and Prevention, up to 27% of adults in the United States have a disability of some kind. Mobility disabilities affect 12.1% of U.S. adults. Despite this, throughout the field of environmental conservation, there is a lack of inclusive practices to provide equal opportunities, especially in terms of fieldwork. This research aims to provide a comprehensive description of the current state of knowledge on the challenges and barriers experienced by disabled individuals in engaging in environmental conservation fieldwork, research, and higher academia. Through a literature review, we intend to identify proposed or implemented strategies for addressing these challenges, evaluate their success, and discuss any gaps in disabled representation. This study is important to environmental sciences, specifically those with a heavy emphasis on research performed out in the field, which is commonly difficult for non-able-bodied persons to participate in. While it is expected that there will be few sources specific to the study goals, foundational knowledge on adjacent subjects and disability accommodations suggests that appropriate strategies already exist and can smoothly be transitioned and implemented within environmental conservation fieldwork and research. The findings from this research can be used to highlight and implement methods of inclusion for fieldwork and help strengthen the inclusivity of outdoor spaces.

Mentor(s): Ashley Dayer, Fish and Wildlife Conservation, Virginia Tech
Sami Thomas, PhD student in Department of Fish and Wildlife Conservation, Virginia Tech

Emily Mulcahy

Virginia Tech/Biological Sciences - Ecology, Evolution, and Behavior

Assessing the Role of Phytoplankton on the Biogeochemistry in Geographically Isolated Wetlands

Phytoplankton serve vital roles as bioindicators for freshwater ecosystems' health and energetics. Still, there is a lack of research on phytoplankton and their role in carbon cycling in geographically isolated wetlands (GIWs), ecosystems with substantial contributions to landscape-scale carbon fluxes. To evaluate the role of phytoplankton in these ecosystems' carbon metabolism, we studied three GIWs of varying depths and hydrological regimes located on the Delmarva peninsula in the US mid-Atlantic. In 2023, we measured dissolved oxygen (DO) using high-frequency sensors and sampled surface water chlorophyll-a concentration as a proxy for phytoplankton abundance. Samples were taken quarterly, capturing wetland drawdown and rewetting periods. We also quantified primary productivity in the least-hydrologically variable site using light/dark bottle experiments in mid-July and late September. We found that chlorophyll-a at our most-hydrologically variable site was consistently low (<5 ug/L). Our semi- and least-hydrologically variable sites, however, had chlorophyll-a averages of 13 ug/L (range: 2-47 ug/L) and 19 ug/L (range: 0-64 ug/L), respectively. Incubations revealed that our least-hydrologically variable site has a GPP:ER > 1 (chlorophyll-a: ~10 ug/L), indicating that GIW water columns can be autotrophic. Ongoing work integrates the metabolism estimates from the incubations with the DO daily fluxes at this site (ranging from 2.4-8.5mg/L over the incubation days). This data establishes a relationship between phytoplankton and the ecosystem's overall metabolism, which contributes to the understanding of GIWs' greenhouse gas dynamics. Future steps include comparing metabolism data to different types of wetlands and identifying phytoplankton population dynamics throughout the year.

Mentor(s): Erin Hotchkiss, Department of Biological Sciences, Virginia Tech

Henriette Muller

Virginia Tech/Chemistry

Development of polymeric materials to address unmet medical needs

Despite significant scientific advancements in medicine, there are still many areas for materials in medicine to be improved. Herein, we demonstrate three areas that advance patient outcomes using three methods of polymer synthesis with distinct morphology:

1) A chemo-filtration device to remove off-target toxicity during chemotherapy treatment.

To mitigate off-target toxicity in chemotherapy treatment, we developed a polymer resin that can be deployed via catheter downstream from the tumor to effectively capture doxorubicin (DOX), a chemotherapeutic agent, before it reaches other organs. We synthesized this material by copolymerizing methacrylic acid and ethylene glycol dimethacrylate in the presence of several nucleobases (adenine, cytosine, xanthine, and thymine).

2) An antibacterial catheter to reduce hospital infection rates.

15-20% of hospital patients need a urinary catheter, but catheter associated urinary tract infections (CAUTI) can occur when Pseudomonas aeruginosa forms surface-associated biofilms on the catheter. To decrease CAUTI, we coated polyvinyl chloride (PVC) catheter tubing with polydopamine (PD) and Gentamicin, an aminoglycoside antibiotic, and we found that bacterial film formation was effectively inhibited.

3) A bioadhesive for tissue repair during spinal surgery.

The challenge of making an effective dural sealant is twofold. First, the sealant must be sufficiently hydrophobic to repel CSF. Second, the material must adhere to the dura with sufficient strength to resist CSF leaks over time. These two attributes are often in tension, however, as highly hydrophobic materials often do not strongly adhere to the dura.

We have investigated the synthesis of polymeric hydrogels to be used for tissue repair.

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

Ebony Myers
Virginia Tech/Sociology

Endocrine Disruption or Cytotoxicity? Deciphering the Effects of PFOS on Amphibian Brain Development

PFOS is banned stain repellent that is a type of PFAS, a category of chemicals commonly referred to as "forever chemicals." These substances are known for their bioaccumulative nature and their resistance to degradation in the environment. Emerging data indicates that PFOS may disrupt thyroid hormone (TH) signaling, which plays a pivotal role in the healthy development of the brain in vertebrates, including humans. Our study aimed to investigate whether PFOS interferes with TH-dependent developmental changes, particularly in brain development, in Xenopus laevis larvae. To assess this, we exposed larvae at Stage 45 to varying concentrations of PFOS (25 µg/L, 2.5 µg/L, and 250 ng/L). Additionally, some larvae were exposed to either 15 µg/L or 1.5 µg/L of thyroxine to evaluate PFOS's potential interference with TH-dependent developmental mechanisms. After 4 days, we euthanized larvae and examined body length, dissected out brains and performed immunostaining for a marker of neuronal proliferation. We found that PFOS significantly impeded overall body growth in a dose-dependent manner, irrespective of TH status. Moreover, PFOS exhibited contrasting effects on brain development. In larvae not treated with TH, PFOS increased neuronal proliferation, whereas in larvae treated with TH, PFOS reduced neuronal proliferation. Additionally, PFOS hindered brain growth in all groups. Ongoing experiments examining the impact of PFOS on limb bud development in larvae exposed to TH. These findings suggest that PFOS may disrupt TH-dependent mechanisms involved in brain development, but the observed pattern of change suggests that its impact could be cytotoxic and may not solely stem from a canonical endocrine disruption mechanism.

Mentor(s): Dr. Christopher Thompson, Virginia Tech

CJ Nance
Virginia Tech/Psychology
Casey Kozan
Virginia Tech/Psychology
Ellie Townsend
Virginia Tech/Psychology

Psychological Safety Within the Transgender Community at Virginia Tech

This study aims to assess the perceptions of interpersonal, environmental, and psychological safety within Virginia Tech's transgender and gender non-conforming student population. This is done both in the interest of understanding what unique obstacles respondents may face because of their identities, and to suggest steps to be taken at the community and administrative levels for a more trans-affirming campus. Participants completed a self-report survey that asked them various questions pertaining to psychological safety, personal safety, perceived social support, and experiences of transphobia while enrolled at Virginia Tech. Results are anticipated to indicate areas of concern students may have. Results will also be used as evidence to push for trans-positive reform in these areas.

Mentor(s): Scott Geller, Psychology, Virginia Tech

Alyssa Nazigian
Virginia Tech/English Literature

A American English Variant: Indefinite determiner variation in American Englishes

The indefinite article a/an is described as following a prescriptive rule whereby “an” precedes a word that begins with a vowel sound, while “a” precedes consonants (an apple vs a banana). However, the use of the indefinite article “a” before a vowel initial word (e.g. a apple) has been described as a feature of both African American English (AAE) and Appalachian English (AppE), but few studies have examined it.
The present study examines pre-vocalic indefinite article variation in AppE and AAE varieties. For AppE, data come from several archival sources: Wolfram and Christian’s (1975) analysis of Mercer County in West Virginia (N=10), Dannenberg’s (2010) restudy of Mercer County (N=10), and Reed’s (2016) study of Smoky Mountain English in Tennessee (N=19). For AAE, data come from the Corpus of Regional African American Language (N=180; Kendall & Farrington 2023), including data from several varieties of AAE. First, we compare overall rates of pre-vocalic a in AppE and AAE, and we find a stark difference in overall rates between AAE (53% a+vowel) and AppE (12.5% a+vowel).
Results indicate that men tend to use the a+vowel variant at higher rates than women, and, for AAE, where social class information is available, there are social class effects where the working class use pre-vocalic a at higher rates than middle class speakers. We consider the results in terms of regional and social variation in American English, to better understand the intersections of standardization, racialized language, and regional variation.

Mentor(s): Charlie Farrington, English, Virginia Tech

William Ngo
Virginia Tech/Biochemistry

Isolation and Characterization of Kunitz and Bowman Birk Trypsin Inhibitors from Soybean Meal

Both Kunitz Trypsin Inhibitor (KTI) and Bowman-Birk Trypsin Inhibitor (BBTI) are anti-nutritional factors in soybean. The aim of this research is to isolate KTI and BBTI from soybean meal samples with the end goal of testing their affinity to serine proteases to unravel their effects on serine proteases needed for the digestion of soybean meal proteins. KTI and BBTI are extracted from soybean meal using sodium acetate buffer and purified using fast performance liquid chromatography-driven gel filtration. The identity of the samples is determined using SDS-PAGE, after which, they are used for isothermal titration calorimetry (ITC) experiments. KTI and BBTI have been successfully isolated from 12 soybean meal samples, and the identity of representative samples confirmed by SDS-PAGE. The next step is to quantify the affinity of the isolated KTIs and BBTIs to serine proteases, including trypsin, chymotrypsin, and elastase, through ITC and select those soybean lines with lowest affinities for crossbreeding purposes.

Mentor(s): Daniel Capelluto, Biological Sciences, Virginia Tech
Ayoyinka Okedigba, Ph.D Candidate, Department of Chemistry, Virginia Tech

Katherine Ngo
Virginia Tech/Biology

Determining the Optimal Approach for Comparing Rhythmic Datasets

Circadian rhythm is an internal process that regulates various biomedical and behavioral processes over a 24-hour cycle. It can be characterized by three parameters: period, amplitude, and phase. While numerous algorithms have been developed and widely utilized to detect rhythmicity and circadian parameters under single conditions, there has been growing interest in the development of algorithms for identifying differential rhythmicity in transcriptomic data under two or more conditions. This study aims to compare the distinct characteristics of six algorithms employed for detecting differential rhythmicity. We present their distinct features, capabilities in detecting rhythmicity and differential rhythmicity, as well as the differential genes detected by each algorithm. We applied the same transcriptomic dataset to each algorithm, consisting of gene expression data from wildtype and Bmal1 knockdown NIH3T3 cells, which is a critical clock gene that maintains gene expression rhythmicity. We found that these algorithms produced varying numbers of differentially rhythmic transcripts. Interestingly, only 27 genes were detected by all six algorithms among the differentially rhythmic genes. These results highlight the significant similarities in rhythmic patterns detected by different algorithms. The outcomes of this study provide valuable insights for researchers, aiding them in selecting the most suitable algorithm for their specific study.

Mentor(s): Shihoko Kojima, Biological Sciences, Virginia Tech

Maxwell Nootbaar
Virginia Tech/Wildlife Conservation
Matthew Graul
Virginia Tech/Wildlife Conservation
William Burgoyne
Virginia Tech/Wildlife Conservation

Using Camera Trap Data to Improve Our Understanding of Avian Communities in Belize, Central America

Avian populations are undergoing significant declines worldwide due to habitat loss and degradation, climate change, overhunting, persecution, invasive species, and other anthropogenic threats. In Central America, anthropogenic effects on avian populations are not fully understood. Birds are a vital component of tropical ecosystems and play important roles as predators, prey, pollinators, seed dispersers, and ecosystem engineers. Historically, camera trapping surveys are primarily used to study large mammals, but avian bycatch in those data are underutilized. We used four years (2016-2019) of camera trapping data initially collected to survey jaguars to assess avian species composition across five sites in the Cayo and Orange Walk Districts of Belize, Central America. These sites included tropical broadleaf and pine forests and tropical savanna. We reviewed 118,000 camera trap images, identified all bird detections, and determined the maximum number of individuals of a given species detected at each camera station per year. We identified 93 avian species representing 18 orders. Galliformes made up most of our data with 11,583 detection events, while Columbiformes and Caprimulgiformes followed (2,009 and 1,114 detections, respectively). We calculated Simpson's (range: 7.51—9.84) and Shannon's (range: 2.46—2.82) diversity indices for each study site and survey year. We found that sites with greater habitat diversity exhibited higher values of both indices, indicating greater species richness and evenness. This research provides a baseline of the avian composition in northwestern Belize and will help facilitate further research of imperiled gamebird species such as the ocellated turkey (Meleagris ocellata) and great curassow (Crax rubra).

Mentor(s): Marcella Kelly, Department of Fish & Wildlife Conservation, Virginia Tech
Robert B. Nipko, Department of Fish & Wildlife Conservation, Virginia Tech

Max Nootbaar
Virginia Tech/Wildlife Conservation

Dispersal Dynamics and Non-Breeding Season Distribution of Piping Plovers Banded in Virginia

The Piping Plover (Charadrius melodus) is an imperiled shorebird species that is experiencing population declines due to threats such as habitat loss, climate change, human disturbance, and increased predation pressures. The Mid-Atlantic region makes up the southern extent of the Atlantic Coast Piping Plover's breeding range. Piping Plover abundance and productivity in this region are highly variable and have undergone a decline since 2016 without clear explanation. Assessing demographic rates such as dispersal may provide insight into evolving threats to Piping Plovers, such as rapid ecosystem change. The objectives of this study are to (1) quantify dispersal dynamics for Piping Plovers breeding on the Virginia barrier islands, a major stronghold for this species in the Mid-Atlantic, and (2) relate these metrics of dispersal to Piping Plover breeding success. We used the re-sight data of 110 Piping Plovers banded by Virginia Tech biologists in 2018 and 2019 on the Virginia barrier islands. Each plover was marked with a unique, three character, green alpha-numeric flag. The re-sight and breeding data for these birds was collected during breeding season surveys conducted by the Virginia Tech Shorebird Program, The Nature Conservancy, and a variety of government agencies. We quantified metrics of Piping Plover natal and breeding site dispersal in Virginia and related those metrics to breeding success. This research will contribute to a broader effort to model Piping Plover population dynamics in the Mid-Atlantic.

Mentor(s): Sarah Karpanty, Department of Fish & Wildlife Conservation, Virginia Tech
Mikayla Call, Department of Fish & Wildlife Conservation, Virginia Tech

Caroline O'Brien

Virginia Tech/Biological Sciences

Investigating S1PR3 Upregulation by Interstitial Fluid Flow in Glial Cells

Glioblastoma is the most common malignant cancer of the central nervous system, and the current standard of care only increases patient survival by a few months. Glioblastoma invasion into surrounding healthy tissue drives poor survival and invasion is driven by enhanced interstitial fluid flow (IFF) at the tumor border. Our preliminary work identified sphingosine-1-phosphate receptor 3 (S1PR3), a receptor driving IFF-enhanced invasion that is amenable to therapeutic intervention. However, astrocytes and microglia—cells present in the glioma tumor microenvironment—are needed to sensitize glioblastoma cells to S1PR3 inhibition. Further, glia upregulate S1PR3 when exposed to fluid shear stress. To examine whether astrocytes and microglia also upregulate S1PR3 in a 3D culture system that more accurately mimics IFF, we analyzed S1PR3 expression in glia collagen hyaluronan hydrogels exposed to a fluid pressure head. We found that S1PR3 RNA expression was not significantly upregulated by increased fluid flow. Contrary to what was seen with the experimental model, increased amounts of S1PR3 were found in regions of flow within astrocytes and microglia in the mouse model. Further research is needed to understand why this was observed.

Mentor(s): Jennifer Munson, BEAM, Virginia Tech
Samantha Howerton, Translational Biology Medicine and Health, Virginia Tech,

Abigail O'Donnell
Virginia Tech/Biochemistry
Emily Galindo Morales
Virginia Tech/Biology
Sydney Omo
Virginia Tech/Biology
Jenna Hilton
Virginia Tech/Biology
Ashley Hunt
Virginia Tech/Exercise and Health Sciences

Lichen Dormancy

Analyzing the Effect of Dormancy over the Photosynthetic Rate of Lichen
Abby O'Donnell, Jenna Hilton, Emily Galindo Morales, Ashley Hunt, Sydney Omo
Word Count: 206
Character Count: 1295

Lichen is a composite organism that forms from a symbiotic relationship between a fungus and an algae. Lichen has a unique ability to go dormant under unfavorable conditions, and then revive once the environment improves. This project sought to investigate the effects dormancy had on the photosynthetic rate of lichen—specifically, the amount of oxygen produced over the course of two weeks. To test the photosynthetic rate of this organism we first placed the lichen in a sealed jar. Once inside, the lichen was then dehydrated using silica gel packets, and an oxygen sensor was placed inside in order to measure the amount of oxygen produced. The oxygen sensor is connected to a Raspberry Pi device that allows the recorded values to be transitioned to our laptops. Over the course of the experiment, we saw a general decrease in the amount of oxygen produced by the dormant sample when compared with the amount of oxygen produced from an active sample of lichen. These results can be applied to other environmental conditions. By testing the different dormant strategies, various photosynthetic rates will likely be observed. By studying lichen's photosynthetic activity throughout dormancy, a greater understanding of oxygen production and the role lichen plays in ecology to be garnered.

Mentor(s): Temperance Rowell, Orion LLC, Virginia Tech

Nicole Odibo
Virginia Tech/Public Health

Development of Surface-Enhanced Raman Scattering (SERS) Based Nanoprobe for Leaf pH Detection

Accurately measuring pH outside of laboratory settings is a persistent challenge due to the lack of portable pH meters and the destructive nature of traditional measurement methods. Our research has sought to overcome these limitations by developing an innovative, efficient, and cost-effective method for pH measurement of both liquid and solid samples. Conventional methods for measuring the pH of solid materials often involve destructive processes such as soaking and grinding, which compromise the integrity of the sample. To circumvent this issue, we devised a non-destructive approach utilizing a nanoparticle-based pH probe and a spectroscopic technique called Surface Enhanced Raman Spectroscopy (SERS). In our method, gold nanoparticles are modified with a reporter molecule, resulting in distinct SERS peaks that correspond to different pH levels. Our method has the potential for in-situ plant health monitoring as it is capable of measuring pH under various conditions since plant pH serves as a key indicator. To determine the pH of leaves, we applied a droplet of pH probe onto the leaf surface, and we subsequently captured SERS spectra. We measured the pH of leaves from five distinct trees, both in their fresh and dried states and achieved accurate pH determination without sacrificing the sample or requiring elaborate equipment. The pH variations between these two states (fresh and dried) are significant. This non-destructive method enables pH measurements to be carried out in non-laboratory settings. Moreover, our method opens up new avenues for future research and real-world applications in the field of pH analysis.

Mentor(s): Peter Vikesland, Civil and Environmental Engineering, Virginia Tech
Sonali Srivastava, Civil and Environmental Engineering, Virginia Tech
Delicia Gonsalves, Civil and Environmental Engineering, Virginia Tech

Nicole Odibo
Virginia Tech/Public Health

A Comparative Analysis of Agrivoltaics and Solar Energy in Virginia and Massachusetts

The Virginia Clean Economy Act mandates Dominion Energy Virginia and American Electric Power to transition to 100 percent renewable energy sources by 2045 and 2050, respectively. Embedded within the Virginia Energy Plan (VEP), this legislation emphasizes the vital need for a reliable, affordable, and sustainable energy framework to meet the demands of Virginia's growing population. As Virginia aims to transition with the shift towards clean energy, understanding its policy framework and environmental factors is crucial. In contrast, Massachusetts stands as an example for fostering an enabling environment for solar energy adoption specifically in the space of agrivoltaics, the use of the same land area for both agriculture and solar energy generation. Through a comparative analysis of state policies and environmental contexts between Virginia and Massachusetts, this research endeavors to assess best practices and identify policies/programs that could advance Virginia's renewable energy transition.

Mentor(s): Ralph Hall, Urban Affairs and Planning (UAP), Virginia Tech

Lillian Olejnicki
Virginia Tech/Industrial Design

Mesh-Harp Hybrids for Anti-Tangling and Anti-Clogging Fog Harvesting

Fog Harps collect fog driven water in regions where water is scarce, but fog is present. Currently, meshes are primarily used, however, this design is prone to clogging which results in poor efficiency. An innovative approach to mitigate clogging in a harvester is to replace coarse meshes with vertical wires. Research has proven that this design has an increased efficiency by two-to-seven times compared to that of a mesh, however, wire-based harvesters have the potential for elastocapillary wire tangling, especially in large-scale implementations, which instead exacerbates concerns of low efficiency. Alternatively,
by integrating horizontal interconnects at intervals along the length of the harp, tangling is minimized, and efficiency is increased. This incremental approach to interconnect placement offers a promising solution to enhance fog harvesting technology.

Mentor(s): Jonathan Boreyko, Department of Mechanical Engineering, Virginia Tech

Katie Orr
Virginia Tech/Biological Systems Engineering

PD-L1 and TGFβ reduce effects of irreversible electroporation on pancreatic cancer

Pancreatic cancer is one of the deadliest types of cancer with low prognoses. Standard treatments options including radiation or chemotherapy have limited efficacy. Research is now focusing on new treatments and combined therapies. Irreversible electroporation (IRE) is a non-thermal ablation therapy that uses high-voltage electrical currents to form nanopores in the cell membrane, causing cell death. However, the immunomodulatory effects of IRE remain primarily unknown. Here we show that an immune checkpoint pathway is responsible for tumor recurrence after treatment with IRE. A murine model of pancreatic cancer was used in this study. We found that IRE reduces tumor burden in both treated and untreated contralateral tumors. Two weeks post treatment, tumors started to grow back. Further analysis revealed that CD8+ cytotoxic T-cells were recruited to the tumor microenvironment after 8 hours and seven days post treatment. Additionally, interferon gamma levels were found increased in the serum. Two weeks after treatment, an increase in PD-L1 was found in conjunction with tumor relapse. In vitro studies revealed PD-L1 expression is IFN-γ dependent. Similar to the immune checkpoint molecule PD-L1, the expression of pro-tumorigenesis molecule TGFβ also coincided with tumor recurrence. To improve responses of pancreatic cancer to IRE treatments, further studies need to be conducted to determine whether blocking PD-L1 and TGFβ could prevent tumor relapse.

Mentor(s): Irving Allen, Department of Biomedical Sciences and Pathobiology, Virginia Tech

Kathryn Ouimet
Virginia Tech/Biological Sciences
Allison Montogomery
Virginia Tech/Ecological Restoration

Corbicula fluminea response to anti-inflammatory drugs when co-exposed with tire-wear particles

Freshwater ecosystems are plagued with thousands of synthetic chemicals. Included in this are over-the-counter anti-inflammatory drugs that are heavily used by humans in their daily lives. The prevalent use of these drugs allows for their pseudo-persistence in nature. Through septic leaching and wastewater effluent, these drugs can enter streams where non-target organisms like Corbicula fluminea can reside. Anti-inflammatory drugs are not present in freshwater systems alone; they are with various other types of pollutants like microplastics that may cause a mixture effect on poorly understood organisms. Microplastics are an emerging contaminant in freshwater habitats; they can enter from atmospheric deposition, runoff, and effluent. Their impact on organisms is well understood, but a subgroup of microplastics (tire wear road particles) are less investigated and even less when co-exposed with other contaminants. Due to this, we are investigating the physiological response of C. fluminea when exposed to TWRPs (1mg/L) and anti-inflammatory drugs (aspirin, ibuprofen, acetaminophen) (25ug/L each) in single and mixture exposure. Clams undergoing a 96-hour acute exposure will evaluate glutathione levels (GSH) in clams to understand whether immune response varies when exposed to these contaminants in a mixture. By assessing the impact of single and mixtures, we can better understand how these resilient organisms respond to pollutants in our ever-changing and polluted freshwater habitats.

Mentor(s): Austin Gray, Biological Sciences, Virginia Tech

Tyler Parker-Rollins
Virginia Tech/Psychology
Emily Steinbach
Virginia Tech/Psychology
Anthony Laub
Virginia Tech/Psychology

Psychological Safety in University Classes: Evaluating Personal Engagement in the Classroom

Psychological Safety, or the degree of perceived inclusion, contribution, belongingness, and comfort one experiences in a given situation, has recently become a topic of extreme interest in industry (Clarke, 2020). Recent research indicates that in workplace settings, psychological safety can increase creativity (Castro et al., 2018), engagement (Frazier et al., 2016), and reduce distress (Obrenovic et al., 2020). Although research on psychological safety has increased dramatically in recent years, this concept has seldom been studied beyond the workplace. Because increasing creativity, improving engagement and reducing distress are all critical factors in improving education, the examination of studying psychological safety in the college classroom warrants systematic empirical investigation. The present study examines student perceptions of psychological safety in individual courses at Virginia Tech through an innovative 38-question survey. To date, 207 students have provided answers to this survey, each responding with reference to a particular university course they have taken within the past year. This questionnaire measures psychological safety with an eight-question "Psychological Safety in Education" scale, adapted from psychological safety scales created for industrial settings. Additional questions on our survey assess variables that may impact a student's perception of psychological safety, including the student's academic year, the number of students in the course, the course subject, and several other issues. While a larger sample is needed for confidence in these results, the current data indicate that perceptions of psychological safety vary significantly depending on the subject matter of a particular course.

Mentor(s): E. Scott Geller, Psychology, Virginia Tech

Savaria Parrish
Virginia Tech/Geosciences

Mineralogical Analysis and Classification of the Kiowa Meteorite Sample Utilizing Electron Microprobe Techniques

In an investigation conducted at the Virginia Tech Corporate Research Center, we applied nanoscale characterization techniques to explore the formation conditions of olivine crystals within a Kiowa County meteorite sample. Utilizing Wavelength Dispersive Spectroscopy (WDS) and Energy Dispersive Spectroscopy (EDS) for elemental mapping and microanalysis, our goal was to delineate the environmental parameters fostering the incorporation of iron-rich and sulfur-rich melts into olivine crystals. Preliminary results have identified the presence of olivine crystals interspersed with inclusions of various compositions, including troilite, schreibersite, and iron oxide, aligning with the characteristic features of pallasites. Challenges in accurately measuring specific elemental concentrations within olivine cracks were encountered, yet the initial data suggests a complex interplay of geochemical processes. The investigation is ongoing, with further analysis required to refine our understanding of the pressure and temperature conditions under which these olivine crystals formed. This research enhances our understanding of the geochemical conditions prevalent during the early stages of planetary formation.

Mentor(s): Lowell Moore, Geosciences, Virginia Tech

Soham Patil
Virginia Tech/Computer Science

Automated segmentation of the thoracolumbar fascia using AI

In 2020, Chronic Low Back Pain (CLBP) affected 619 million individuals globally, with projections indicating a rise to 843 million by 2050 due to demographic shifts and aging [1]. My research harnesses the capabilities of machine learning algorithms like UNet, a state-of-the-art image segmentation tool, to improve the diagnostic accuracy for Chronic Low Back Pain (CLBP) by analyzing the thoracolumbar fascia (TLF) in ultrasound images. By leveraging UNet's architecture within the PyTorch framework, we aim to accurately delineate pathological from normal TLF conditions in ultrasound images, thus advancing the objective assessment and monitoring of CLBP.

The core of my research lies in refining the UNet model to process and segment large ultrasound image datasets effectively, thereby identifying specific biomarkers of TLF pathology. This focus on image segmentation is crucial for advancing the diagnosis of CLBP and assessing the impact of interventions like Osteopathic Manipulative Treatment (OMT). Through detailed analysis of TLF imagery, our findings centered on algorithm-driven segmentation, have the potential to usher in a new era of personalized and effective therapeutic strategies for CLBP, underscoring the profound impact of machine learning and AI in medical imaging.

[1] National Library of Medicine, National Institutes of Health

Mentor(s): Vincent Wang, Department of Biomedical Engineering and Biomechanics, Virginia Tech

Marquesa Peloquin
Virginia Tech/Exploring Life Sciences
Sydney Inge
Virginia Tech/Fish and WIldlife Conservation
Alyssa Giannini
Virginia Tech/Fish and Wildlife Conservation
Amour Dau
Virginia Tech
Emily Stephens
Virginia Tech

The Efficacy of AHDriFT Camera System to Servey for Least Weasels

Weasel populations in North America appear to be declining. However, detecting weasels can be challenging with traditional sampling methods such as trapping and camera traps. New methods, such as Mostela Boxes, exploit the weasel's inquisitive behavior to investigate holes and funnel them in front of cameras. Another new sampling technique that has shown promise with uncommon herpetofauna is the Adapted-Hunt Drift Fence Technique (AHDriFT). This method uses traditional drift fences constructed from construction silt fences and funnel animals towards the fence ends. Animals are photographed as they pass under a camera, allowing for non-invasive, passive sampling. We deployed 2 AHDriFT arrays with cameras and two additional cameras without AHDriFT arrays to serve as controls. We choose areas to deploy arrays where we have frequently detected least weasels. Our efforts are part of a much larger effort by the North American Weasel Monitoring Group to determine the most effective methods of detecting weasels.

Mentor(s): Kevin Hamed, Fish and Wildlife Conservation, Virginia Tech

Aaliyah Perez
Virginia Tech/Meteorology

Shape Analysis of Radar Reflectivity Plots to Detect Hazards Associated with Supercell Thunderstorms

This research used shape analysis to compare ten tornadic and non-tornadic supercell cases in the southern Great Plains and southeastern US. Prior research has identified hook echoes and robust inflow notches as two characteristics that help differentiate a tornadic storm from a non-tornadic storm. However, thus far, all comparisons have been qualitative and no studies have used shape metrics to quantify these spatial features. The radar data were collected from the U.S. Next Generation Weather Radar (NEXRAD) network, and all supercell information was found from the NOAA Storm Events Database. These data allowed us to see if there were any similarities or differences between the supercells' shapes and their associated weather hazards (e.g., tornadoes and hail). Our methods were to set the threshold for reflectivity (Z) to be greater than 20 dBZ to delineate the hook echo, measure the hook echo elongation, and extract the maximum reflectivity. We utilized the Mann Whitney U Test to compare the sample distributions and determine whether there was a significant difference in the two samples. Results show that non-tornadic cases have slightly higher maximum reflectivities than tornadic cases. Unexpectedly, the tornadic cases showed higher elongation values compared to the non-tornadic cases. However, the Mann Whitney U Test results indicated that there was no significant difference between the two groups for either metric. These results may be partially due to the sample sizes being too small. Future work should use a larger dataset to determine if significant differences exist with a larger, more representative sample.

Mentor(s): Stephanie Zick, Geography, Virginia Tech

Victoria Pham
Virginia Tech/Biological Sciences

Raising Poisonous Plant Awareness for Dog Owners in Virginia

Every year, Virginia dog owners call the Animal Poison Control Center (APCC) hotline over 270 times for potential poisonous plant exposure. The APCC hotline is a for-charge service run by the American Society for the Prevention of Cruelty To Animals (ASPCA). Their hotline aims to aid dog owners in responding to a poisonous plant exposure. Our guide aims to help prevent exposures. Using call data from the ASPCA hotline, we have started a guide that features the top 15 genera of concern. The top five genera are Vitis (grapes), Allium (onions, garlic, chives), Prunus (cherries, peaches, almonds), Azalea (rhododendron), and Cannabis (marijuana). Within the those five, Vitis accounted for 30% (1542 of total cases), Allium accounted for 8% (420), Prunus accounted for 5% (276), Azalea accounted for 3% (162), and Cannabis accounted for 2.6% (135) of the cases. Our guide will include pictures, descriptions of their appearances, look-alike species, exposure routes, symptoms, and other relevant information. This document will be published online and be freely available for download. I wish to educate Virginia dog owners before their pets are harmed so they can avoid poisonous plant exposures and thus safeguard their dogs.

Mentor(s): Jordan Metzgar, Biological Sciences, Virginia Tech

Grayson Phillips
Virginia Tech/Biochemistry
Sofia Schmidmeier
Virginia Tech/HNFE
Kyle Crosby
Virginia Tech/Public Health

Focused Ultrasound Extraction (FUSE) as a means to lyse blood cells for DNA extraction

Focused Ultrasound Extraction (FUSE) is a method in which ultrasonic waves create cavitation 'bubbles' on a microscopic scale to mechanically destroy cells and release their contents. Our goal was to test the capabilities of FUSE in the context of blood cell DNA, specifically to see if releasing Mycobacterium Tuberculosis DNA using FUSE would be a more viable method for sample lysing when diagnosing latent and active Tuberculosis (TB) than current rapid detection test (RDT) methods. Current RDT methods are not time and cost-efficient enough for developing countries. Malawi, a developing Sub-Saharan country with a population of roughly 20 million, accounts for over 60% of all known TB cases worldwide. These rates of TB are especially concerning due to the high prevalence of HIV, making the reported death rate of TB 27 in 100,000 (2022) compared to the US death rate of 0.2 in 100,000 (2020). This study serves as a preliminary trial to test the capabilities of FUSE lysing of blood samples. To do this, different ultrasonic pulse dosages were applied to swine blood samples, and the length of DNA extracted was measured using a nanodrop spectrophotometer and gel electrophoresis. We anticipated maximum DNA extraction at a pulse rate of 10,000 pulses over 40 seconds at a rate of 250 pulses per second. This research will hopefully lead to further testing on tuberculosis-infected blood cells to see if FUSE lysing is an effective method for DNA extraction.

Mentor(s): Andy Muelenaer, Biomedical Engineering, Virginia Tech
Sarah Hall, Biomedical Engineering, Virginia Tech
Alexia Stettinius, Biomedical Engineering, Virginia Tech

Ryan Pho
Virginia Tech/Biochemistry

Adrenergic Receptor Antagonists Reduce Herpes Simplex Virus 1 Recurrences but Not From Sensory Neurons

Stress causes herpes simplex virus 1 (HSV1) recurrences. We previously showed epinephrine, the "fight or flight" stress hormone, reactivates HSV1 by activating certain adrenergic receptors. HSV1 establishes latency in sensory and sympathetic neurons, but epinephrine selectively reactivates HSV1 in sympathetic neurons by activating at least two adrenergic receptors (AR), including any combination of alpha-2 (AR-α2), beta-1 (AR-β1), or beta-2 (AR-β2). We hypothesized that AR inhibitors would decrease HSV1 viral reactivation. In guinea pigs, atipamezole (a specific α2-AR inhibitor), propranolol (a nonspecific β-AR inhibitor), or a combination of both decreased HSV1 recurrences. After infecting cultured primary adult sensory neurons with HSV1 and establishing latency for 7 days, neurons were treated with atipamezole, propranolol, or a combination of both at various concentrations. After 24 hours, neurons were collected, DNA was extracted, and HSV1 DNA was quantified by qPCR. In sensory neurons, none of the treatments had significant effects on latent HSV1. Since these AR antagonists reduced HSV1 recurrence in guinea pigs but had no effect on latently infected sensory neurons in vitro, our results suggest that the medications acted on sympathetic neurons in vivo to reduce HSV1 reactivation. Future studies will test these treatments in latently infected sympathetic neuronal cultures to determine if AR antagonists inhibit HSV1 reactivation in these neurons. These adrenergic receptor inhibitors may lead to potential clinical solutions for individuals susceptible to frequent viral recurrences of HSV1.

Mentor(s): Andrea Bertke, Population and Health Sciences, Virginia Tech
Jillian Green, Biomedical and Veterinary Sciences, Virginia Tech
Greyson Moore, Biomedical and Veterinary Sciences, Virginia Tech

Anna Pletch

Virginia Tech/Environmental Resource Management

Understanding how fruit-frugivore interactions affect range shifts in plants across Appalachia

The goals of this project are to: 1) identify important fruit-frugivore relationships for Ilex montana (winterberry) within Appalachia, and 2) visualize the predicted ranges of Ilex montana and associated frugivores using the projected environmental state within the next 20-50 years. Mapping the range in which frugivores and fruit-bearing plants are found in Appalachia is important to specifying which relationships are present within these ecosystems and in hypothesizing how those relationships will alter in the future. With an ever-changing climate, certain species of animals and plants may experience limiting climatic factors in different geographical locations than in times past. The movement of both plants and frugivores as climate change progresses may impact the quantity and quality of their interactions, and establishing which animals and plants have mutually beneficial relationships as well as their current and future ranges will assist in understanding how Appalachian ecosystems will change over time. Occurrence data for Ilex montana and present-day and future bioclimatic variables will be entered into the Maxent software to produce the current and future possible ranges of the plant, and we are expected to obtain results as to how Ilex montana's range will shift as well as how that range shift will look compared to the ranges of the frugivores that distribute its seeds.

Mentor(s): Haldre Rogers, FIW, Virginia Tech

Jaya Powell Powell
Virginia Tech/Psychology

Relations between Internalized Moral Values and Prosocial Behavior: The Mediating Role of Guilt

Prosocial behaviors are voluntary acts intended to benefit others (Carlo, 2006). Altruistic prosocial behavior refers to helping others with no expectation of reward or recognition for oneself, while public prosocial behavior refers to helping others in the presence of an audience with the intent to receive reward or recognition (Carlo, 2006). According to self-determination theory (Ryan & Deci, 2000) and prosocial development theories (Carlo, 2006), internalized moral values are positively associated with altruistic and negatively associated with public prosocial behaviors because internalized moral values intrinsically motivate individuals to perform such behaviors. However, the mechanisms that account for this relation are not clear. One possible explanation might be the moral emotion of guilt. Guilt is characterized by negative feelings when one violates their internalized moral values and motivates individuals to do reparations after wrongdoing (Carlo et al., 2013). Prior research has found guilt to be positively associated with altruistic and negatively associated with public prosocial behaviors among college students (Gulseven et al., 2022). The present study aims to explore the mediating role guilt in the relation between internalized moral values and public and altruistic prosocial behaviors. The sample consisted of 601 midwestern college students (Mage= 19.28, SD =1.34; 64% men). Path analyses indicated that internalized moral values were positively related to guilt, which, in turn, was negatively related to public and positively related to altruistic prosocial behavior. Overall, these findings shed light on the mediating role of guilt in the relation between internalized moral values and prosocial behavior in early adulthood.

Mentor(s): Zehra Gulseven, Psychology, Virginia Tech
Kennedy Kreidell, Psychology, Graduate Student, Virginia Tech

Graham Prather-Long
Virginia Tech/Computer Science
Evan Lee
Virginia Tech/Computer Science
Mikayla Dolo-Pittman
Virginia Tech/Mechanical Engineering
Pierce Bell
Virginia Tech/Construction Engineering Management

Multidisciplinary Undergraduate Research on Multi-System Robots in Construction

This project is a multidisciplinary (CS, ME, and CEM) undergraduate research on a multi-agent robot system for construction inspection. The goal of this research is to integrate an unmanned aerial vehicle (UAV) and an unmanned ground vehicle (UGV) on construction sites in order to perform real-time inspections for the Stormwater Pollution Prevention Plan (SWPPP), a plan required by the EPA to prevent stormwater pollution. We developed a Multi-Robot Construction Inspection System (MRCIS) as a multi-agent assistant to human inspectors in SWPPP inspection. This solution can potentially (a) remove human workers from hazardous construction environments and (b) reduce project errors by enabling frequent inspections. The research methodology in this study includes developing a computational framework for MRCIS, developing a prototype of MRCIS, and undertaking an experimental investigation to validate MRCIS. The MRCIS system architecture involved establishing a backend server as a control hub for the UAV and UGV to organize all control logic and data processing, data transmission, and command issuance. Also, a client interface allows users to control the robots and view a live video from the robot cameras. MRCIS framework supported by robust network connections with the robots, ensures a scalable and reliable solution for remote robot control and site inspection. For the experimental investigation, this study uses a DJI Tello drone and a Clearpath Husky robot. The project results have shown a viable solution for SWPPP inspection using the developed multi-agent robotic system that can benefit construction projects.

Mentor(s): Kereshmeh Afsari, Myers-Lawson School of Construction, Virginia Tech

Sam Purvis
Virginia Tech/Biological Sciences
Tessa Thibodeau
Virginia Tech/Biological Sciences
Allison Montgomery
Virginia Tech/Ecological Restoration
Kathryn Ouimet
Virginia Tech/Biological Sciences
Persephone Blackwell
Virginia Tech/Biological Sciences
Arianna Porter
Virginia Tech/Biological Sciences
Julia Cheng
Virginia Tech/Biological Sciences
Anna D'Alessandris
Virginia Tech/Biological Sciences

A comparative assessment of Tire Wear Particle Toxicity by brand

The goals of this research were to determine the differences in toxic effects of Tire Wear Particles (TWPs) based on Tire brand and in comparison to 6PPDQ. This is a large scale issue as approximately 6 million tonnes of tire particles are released into the environment anually causing unknown damages to aquatic environments. The process was done by blind sampling tire brands A-F and releasing leachates with methanol. The solution was then diluted from concentrations ranging 1%-50%. Five daphnia were exposed to each concentration with three trials per concentration in a 48 hour mortality study to establish a LC50.

Mentor(s): Austin Gray, Biological Sciences, Virginia Tech

Isabel Quintana
Virginia Tech/Biomedical Engineering
Mackenzie Olsen
Virginia Tech/Biomedical Engineering
Bharath Kashyap
Virginia Tech/Biomedical Engineering
Reilly Breen
Virginia Tech/Exercise and Health Sciences

Feasibility of Using Histotripsy-Generated Liquid Biopsies to Diagnose Breast Cancer in Malawi

Breast cancer has a high incidence and mortality among women in Malawi coupled with limited to no resources available for diagnosing this disease. Histotripsy is a non-invasive, non-thermal focused ultrasound technology being developed for cancer treatment. Histotripsy generates cavitation at peak negative pressures exceeding 28 MPa, which causes liquefication of target tissue. The body resorbs this liquefication over time, however, it could potentially be used as a liquid biopsy. Our research aims to use histotripsy-generated liquid biopsies in combination with downstream gene analysis of five genes (ECT2, CHST11, MSLN, ANLN, and LAMA2) to diagnose breast cancer. A custom-built 500 kHz histotripsy transducer was used to extract DNA from 4T1 murine breast cancer cells at a pulse repetition frequency of 250 Hz and dosages from 0 to 150,000 pulses. Brightfield and fluorescence microscopy were used to quantify cell viability after treatment. A nanodrop spectrophotometer was used to measure the quantity and quality of extracted DNA. DNA fragmentation was visualized with gel electrophoresis. Results showed that 4T1 cells can be fully ablated at lower dosages (<150,000 pulses). Ongoing experiments are characterizing DNA extraction and fragmentation. We anticipate that DNA quantity will increase as cell viability decreases due to cell membrane disruption. We also expect DNA fragmentation to increase as dosage increases. This work will determine treatment parameters to maximize extraction and minimize damage of DNA, which can be used to analyze the expression of genes that correspond to the different stages of breast cancer.

Mentor(s): Eli Vlaisavljevich, Biomedical Engineering and Mechanics, Virginia Tech
Dr. Andy Muelenaer, Biomedical Engineering and Mechanics, Virginia Tech

Madeline Radosevic
Virginia Tech/Animal and Poultry Science

The Evaluation of Equine Diets for Determination of Nutrient Deficiencies and Surpluses

Having a balanced diet is an important part of equine welfare. Unbalanced diets have been attributed to cause poor performance, behavioral issues, poor hoof and coat quality and failure to maintain condition. More serious issues such as colic, ulcers or laminitis can also be attributed to an incorrectly balanced diet. The aim of this study was to evaluate diets of horses using the 2007 NRC guidelines including ratios for the micronutrients. Horses were fed ad libitum first cutting grass hay. All horses received at least one supplemental source of calories. The amount of energy (megacalories) and nutrients each horse required per day was calculated using their current bodyweight in kilograms. We determined that 32 horses had an unbalanced diet with the most common deficiencies being in Copper (90.6%) and Zinc (96.9%). Thirty-two horses had a surplus of iron which we established as the primary cause of Copper and Zinc deficiency. Sodium and Chloride deficiencies could be correlated with the amount of megacalories a horse received from hay, with Chloride deficiency linked with low hay intake and Sodium deficiency being linked with high hay intake. These trends show that the average horse likely has an unbalanced diet which could be negatively affecting performance, behavior and overall health. Additionally, hay cutting and variety can play a large role in the nutritional value of hay, which could impact horse health as hay or pasture is the majority of most horses' diets.

Mentor(s): Erica Feuerbacher, School of Animal Science, Virginia Tech
Rebecca Thompson, School of Animal Science, Virginia Tech

Aadil Rana
Virginia Tech/Computational and Systems Neuroscience
Caroline Schottler
Virginia Tech/Clinical Neuroscience
Halley Headrick
Virginia Tech/Computational & Systems Neuroscience
Lila Harshbarger
Virginia Tech/Cognitive and Behavioral Neuroscience
Michael Galligan
Virginia Tech/Cognitive and Behavioral Neuroscience

Neuroscience Demos for Elementary and High School Students

The Neuroscience of Drug Addiction course that we are currently enrolled in incorporates service learning. Our team chose to engage in neuroscience outreach events targeting a younger audience, specifically 5th graders and high school students. Students often have a hard time finding topics they want to further pursue in higher levels of education. Often not having exposure to a variety of topics can tunnel students into choosing majors that they may not be genuinely passionate about all in the name of completing a degree simply to secure a job. Even if they have a general idea of which fields interest them, such as health or science, these fields are rather broad and interdisciplinary. Students may lack the awareness of specializations or disciplines within these fields. We aimed to address this by introducing one such discipline, neuroscience, to elementary and high school kids in an interesting and engaging way. Through multiple demos, we showed real-world examples of how neuroscientific approaches are used to study the brain and behavior to these school students to hopefully ignite an interest in this field. The main goal of these outreach events was to educate students on how substance use affects the brain. To help achieve this goal our demos were focused on research methods used in studying the neuroscience of addiction. We hope that similar outreach events can be conducted more frequently and easily in the future. Accordingly, we plan to optimize the demos and address any issues that arose during the events.

Mentor(s): Aparna Shah, College of Neuroscience, Virginia Tech

James Rashkovsky
Virginia Tech/Microbiology

Protoplast but Not Least: Upping the Ante in Transformation Efficiency

Transient transformation of protoplasts (plant cells that lake a cell wall) is a technique used to asses gene expression, promoter elements, and transcription factors. In combination with flow cytometry and positive fluorescent selection, this allows us to get an accurate measurement of the rate of transformation on our cells. One problem we face now that we have these accurate measurements is low transformation rates. In this experiment we set out to test what kind of factors during the process affect the transformation efficiency. Our data suggests that temperature, number of cells, and the age of the buffers used play a role in the amount of successful transformed cells.

Mentor(s): Bastiaan Bargmann, School of Plant and Environmental Science, Virginia Tech
Joseph Taylor, School of Plant and Environmental Science, Virginia Tech

Hannah Raso
Virginia Tech/Dairy Science

Immune response to Sars-CoV-2 in white-tailed deer milk

A defining trait unique among all mammals is lactation for beneficial nourishment, passive immunity and emotional bonding between mother and offspring. However, in some instances, milk may be the source of harmful microbial transmission. Human breast milk contains SARS-CoV-2 antibodies in previously exposed and vaccinated mothers and there is no conclusive evidence for the transmission of SARS-CoV-2 during breastfeeding. To date, there have not been any investigations regarding SARS-CoV-2 antibodies or viral particles in the milk of susceptible non-human mammals. Therefore, we examined the effect of SARS-CoV-2 in serum and milk of white-tailed deer (WTD) during the 2022 and 2023 Virginia deer hunting seasons. The presence of neutralizing antibodies was evaluated by using species independent qualitative lateral flow assays from three commercial sources. Approximately half of the WTD were noted to display antibodies in both serum and milk. In addition, there was a relatively greater percentage of SARS-CoV-2 antibody positive WTD harvested in the more densely populated human neighborhoods as opposed to rural farms. In conclusion, this is the first study to demonstrate SARS-CoV-2 antibodies in the milk of a non-human mammal. The maternal antibodies most likely provide the naïve WTD fawn with variable passive immunity towards SARS-CoV-2 infection, thereby potentially diminishing intra-species transmission within the herd. Furthermore, the finding of increased SARS-CoV-2 antibodies within WTD living in close proximity to humans is supporting evidence for mutual human/WTD SARS-CoV-2 exposure and potential zoonotic transmission

Mentor(s): Carla Finkielstein, Department of Biological Sciences, Virginia Tech

Ella Reitmeier
Virginia Tech/Psychology

Use of an Asset Frame in Nutrition Education Reporting to Reduce Stigma

Federally-funded nutrition education programs (e.g. the Supplemental Nutrition Assistance Program-Education, SNAP-Ed), produce annual reports on program impacts and outcomes. These reports have traditionally used a "deficit frame", which potentially stigmatizes participants. In order to move away from these stigmatizing reporting practices, an "asset frame" should be used instead, where participants are defined by their contributions and strengths. The purpose of this project was to determine how the language in the Virginia SNAP-Ed 2022 annual report aligns with asset-framing concepts. Content coding was used to identify instances of asset- and deficit-based framing. Codes were developed a priori using the toolkit "Asset-Framing and Ethical Storytelling: A Toolkit for Centering Equity when Communicating Programmatic Success" by the National Association of SNAP Nutrition Education Administrators. The report was coded by one researcher and reviewed by a second. Seven instances of stigmatizing languages were identified. One was "low-income families" and the other six were instances where "SNAP-eligible" was used to describe a group of people. Both are examples of presenting challenges as personal characteristics. Overall, the report did not frequently utilize the deficit frame. However, asset-framing practices were also not explicitly used. These findings reveal the need for strategies to move from stigmatizing and neutral language to an empowering, asset-based approach.

Mentor(s): Sarah Misyak, HNFE, Virginia Tech
Anna Zeide, Department of History, Virginia Tech,

Jordan Rhodes
Virginia Tech/Biochemistry

Using Virtual Screening Methods to Develop Antivirals for Proteases, Transferases, and Polymerases in Dengue and Chikungunya Viruses

Arboviruses, including chikungunya virus (CHIKV) and dengue virus (DENV), pose a continuous global health threat, largely due to their rapid mutation rates. Health risks are compounded by the lack of available treatments to combat these viral infections after transmission. While previous studies have identified several compounds that exhibit antiviral activity for other RNA viruses through inhibiting viral proteases, little has been done to assess the efficacy of potential antivirals with respect to these arboviruses. In this study, we will be performing virtual screening on known CHIKV and DENV protease structures, in addition to viral transferases and polymerases. Stock is currently being taken of all existing crystal structures for the proteases, transferases, and polymerases of DENV and CHIKV. A complete inventory will allow for a more in-depth understanding of the proteins' binding pocket, and potential for inhibition, which in turn will be used for the initial selection of compounds for virtual screening. We aim to identify antiviral drug candidates for further study in silico and in vitro environments. Successful drug candidates will be studied using molecular dynamics simulations, to get an atomistic understanding of the ligand-protein complex in dynamic environments. These results will help pinpoint the best path to further the development and research of these potential antivirals to curb the serious health threat that these viruses pose.

Mentor(s): Anne Brown, University Libraries, Virginia Tech

Tre Ridgway-Davis
Virginia Tech/Psychology

The effects of triclosan (TCS) on mitochondrial gene expression in the brains of Xenopus laevis larvae

Triclosan (TCS) is an antimicrobial agent found in a variety of consumer health products ranging from detergents and cosmetics to industrial products like mortar and grout. It is readily absorbed through the skin and can be found in urine and breastmilk. Prior research indicates that TCS is neurotoxic at sufficiently high concentrations. While it was once thought that TCS disrupts thyroid-hormone signaling, current data show that it more likely interferes with mitochondrial physiology. Very little is known about the effects of TCS on mitochondria in the developing brain, however. Prior research in our lab has shown that TCS reduces neuronal proliferation in the brains of Xenopus laevis larvae, which is dependent upon healthy mitochondria. The goal of our study is to assess the degree to which TCS affects the expression of mitochondrial-related genes. To elucidate possible mechanisms of action, we measured the gene expression of several previously identified genetic markers of mitochondrial uncoupling, i.e., the dissociation of electron transport from ATP synthesis, and compared their expression in the brains of TCS-treated Xenopus laevis larvae to that of larvae treated with the well-characterized mitochondrial uncoupler FCCP. We treated tadpoles for 2, 4, or 24 hours, dissected brains, and extracted RNA. What remains is determining mRNA expression using ddPCR. Our results will shed light on the effects of TCS in the developing brain.

Mentor(s): Christopher Thompson, School of Neuroscience, Virginia Tech

Tre Ridgway-Davis
Virginia Tech/Psychology
Rilee Anderson
Virginia Tech/Cognitive and Behavioral Neuroscience
Sara Bannwart
Virginia Tech/Cognitive and Behavioral Neuroscience
Sarah Cunningham
Virginia Tech/Cognitive and Behavioral Neuroscience

Expanding The Just Say Know (JSK) Substance Use Education Program to Southwest Virginia Elementary and High School Students

The Neuroscience of Drug Addiction course that we are currently enrolled in incorporates service learning. There is a lack of empirically supported drug-education programs in the United States. Accordingly, the goal of our team's service-learning project was to educate adolescents about the neuroscience of substance use using content developed for the Just Say Know (JSK) program. The JSK program is a substance use prevention program geared towards adolescent audiences, and its objective is to provide education about the physiological effects of drugs of abuse on the developing brain. The original JSK presentation was developed under a different pretext and for an audience with different educational backgrounds. With the assistance of our community partner, Dr. Samantha Kemper-Margherio, we revised the previous JSK presentation to suit the educational demographics of our audience, i.e., 5th and 9th grade students from Southwest Virginia. Some of the changes we incorporated were storytelling, interactive activities, active learning strategies, and content adjustments (to meet time constraints). Based on the level of engagement and qualitative feedback, we believe this was a step in the right direction towards promoting empirically supported, education-based substance use prevention programs in the United States. This project was intrinsically rewarding and allowed us to gain experience communicating sensitive and complex topics to younger, lay audiences. These are skills that are directly translatable to our shared goals of becoming healthcare and social-service providers. We are currently in the process of renewing this program for upcoming semesters.

Mentor(s): Aparna Shah, School of Neuroscience, Virginia Tech
Dr. Samantha Kemper-Margherio, Department of Psychology, Virginia Tech

Clara Riggan
Virginia Tech/Fish and Wildlife Conservation

Exploring seasonality in jaguar mating behavior via remote camera traps, in Belize

There is little known about mating seasonality for jaguars (Panthera onca) across their range. Past data is scarce and conflicting. Observations conducted in Brazil support the assumption of year-round mating, however no other studies have reported on mating seasons in wild jaguar populations. We used data collected from remote cameras between 2004 and 2023 across 5 sites in Belize, Central America, to document timing of jaguar mating events. We considered jaguars a potential mating pair when adult males and females were photographed traveling together (i.e., in consort). We organized data by events per month and year. To account for differences in numbers of cameras and length of camera deployment across surveys, we divided mating events by number of trap nights (TN), and multiplied by 1000 to estimate a mating rate per month and year We also separated data by pine forest versus broadleaf forest sites. We found 86 potential mating pair events (only 4 of which were in the pine forest), with 12 actual mating events in front of cameras across 7 different mating pairs. Once corrected for trap nights, frequency of events remained similar across all years ($\bar{x}$=1.02/1000 TN; SE=0.17). Frequency of monthly events did not show strong seasonal patterns, though actual mating events occurred in June, July, and August. We documented one female mating with more than one male. Further analyses will explore whether in-consort events involve repeated potential mating pairs or different mating pairs. Our preliminary results indicate no clear pattern in timing of jaguar mating events.

Mentor(s): Marcella Kelly, Fish and Wildlife Conservation, Virginia Tech

Ethan Ririe

Advanced Studies Blacksburg High School Student

Investigating the Impact of Parasitic Worm-Induced Secretions on Anaphylaxis

A sharp rise in food allergies during the last century has left millions with this chronic, often life-threatening condition. In fact, nearly all known autoimmune diseases are being diagnosed at higher rates than ever before, even after accounting for improvements in diagnosis techniques. Leading theories attribute this rise in immune disorders to a lack of exposure to "Old Friend" pathogens that evolved alongside humans for millennia. This study attempts to prove the veracity of the "Old Friends" hypothesis by reintroducing human tissue to the conditions created by Necator Americanus infection, determining whether the presence of N. Americanus is able to "undo" existing autoimmune disorders.

This study simulated N. Americanus infection using the two major induced-secretory products of the helminth, interleukins IL-4 and IL-10. Helminths have been shown to be able to suppress the anti-parasitic effects of the body's IgE antibody pathway to avoid being killed. However, the specifics of how they inhibit the IgE pathway are still not fully understood. Because IgE is also responsible for activating mast cells in certain inflammatory disorders, it was theorized that parasitic worm-induced secretions would be able to alleviate allergic inflammation. The interleukins IL-4 and IL-10 were administered to blood samples and an Enzyme-Linked Immunosorbent Assay (ELISA) was used to detect the presence of key inflammatory molecule tryptase. Optical density data gathered by microplate reader showed that there was a significant decrease in inflammation through IL-4 stimulation but not through IL-10 stimulation.

Mentor(s): Xin Luo, College of Veterinary Medicine, Virginia Tech

Peyton Rowe
Virginia Tech/Environmental Science
Jared Rasmussen
Virginia Tech/Fish Conservation Major with Freshwater Fisheries

Observing changes in macroinvertebrate density and evenness across biomes

Macroinvertebrate communities reflect the physical and chemical properties of ecosystems. The sensitivity of different species to environmental changes can be utilized to characterize the health of streams. We measured and compared the richness, density, and evenness of macroinvertebrate communities in streams across five different sites in North America to observe relations across biomes. Data was gathered from the National Ecological Observatory Network (NEON) from 2018 to 2022, from streams draining landscapes dominated by a temperate coniferous forest, a Rocky Mountain forest, a temperate deciduous forest, a boreal woody wetland, and a midwestern prairie where the stream dries annually. Data were analyzed using RStudio. Species evenness was calculated using the Shannon-Wiener diversity index. Density was calculated by dividing the estimated macroinvertebrate counts by the benthic area sampled. We found a general negative correlation between macroinvertebrate evenness and density. The values for species evenness range from 0.5197 to 0.7946 and the values for density range from 22.91 to 559.9 individuals/m2 across 5 years for all sites. By observing areas with lower species evenness relative to a high density, we assume the allocation of resources singled out by a dominating species, resulting in a generally more unstable environment compared to areas with a higher species evenness and lower density.

Mentor(s): Erin Hotchkiss, Department of Biological Sciences, Virginia Tech

Rupabali Samanta
Virginia Tech/Clinical Neuroscience

Investigating the Effect of Peripheral CSF Overexpression on Microglial Function in Ovarian Tissue

Stress has been implicated in contributing to various mood disorders, including depression, as well as associated with gastrointestinal disorders. After exposure to psychological stress, the immune system can influence the activity of the gut and the composition of the gut microbiome. Colony-stimulating factors (CSF) are signaling proteins associated with immune activation. In this project, we sought to investigate whether overexpression of CSF leads to alterations in the microglial activity of ovaries in female mice. Ovary and brain tissue were collected after genetic modification of the CSF gene via jet-PEI, a non-viral CRISPR-cas9 gene editing system. Ovaries and brain tissue were dissected with a 30-micron thickness using a cryostat microtome. Immunohistochemistry for the ligand- m-CSF, the receptor- CSF1R, and the microglia marker- IBA1 was performed on these tissues following dissection. Imaging was obtained via a Nikon A1 confocal microscope, and image analysis was conducted using Imaris software (v9.8.2). While the systemic overexpression of CSF was found to not have occurred in the brain, it did affect the ovaries, which demonstrates that this jet-PEI system could not penetrate the Blood-Brain Barrier. This project highlights the utility of jet-PEI agents for peripheral gene manipulation and could reveal the effects of CSF overexpression on microglial function in ovarian tissue.

Mentor(s): Georgia Hodes, Neuroscience, Virginia Tech
Tim Jarome, Animal and Poultry Science, Virginia Tech
Dawson Kropp, Neuroscience, Virginia Tech

Emily Samples
Virginia Tech/Physics
Bella Guereca
Virginia Tech/Physics
Fir Takacs
Virginia Tech/Physics
Nathan Brozak
Virginia Tech/Physics

Investigation Into the Effect of Galaxy Distance on SoFiA's Error Rate

With many galaxies, automating the detection of galaxies is a sought-after process in astronomy. As such, the SoFiA software is used to detect neutral hydrogen (HI) emissions to use in many things such as mapping the galactic zoo, determining and predicting the formation of galaxies, and many more activities significant to developments of astrophysics. However, not all software is perfectly accurate and therefore the following question arises: what is the effect of distance from Earth on the frequency and severity of error in the SoFiA software as it analyzes data cubes? By focusing on only one potential source of error, this project intended to determine whether it might be more reliable to utilize SoFiA in the detection of closer galaxies as opposed to farther ones, assisting other researchers in determining the accuracy of previous detections, as well as in improving Sofia. CASA and CARTA are used by the researchers to analyze data cubes to find HI emissions in galaxies. Once possible detections are made, researchers search the NED NASA database to determine if the detection is real. This is done by comparing the ascension, declination, and velocity to objects in NED NASA. If a detection is verified by researchers, then calculate the HI flux and mass. A SoFiA mask is then applied to the data cube and compared to the detections made by the researcher. When galaxies are found at higher velocities SoFiA’s accuracy is expected to decrease.

Mentor(s): Temperance Rowell, College of Science, Virginia Tech
Danielle Lucero, Department of Physics, Virginia Tech

Daniela Sanchez

Virginia Tech/Philosophy, Politics and Economics

Community Engagement Research

This research paper dives into my critical self-reflective journey of personal experiences with service-learning. It delves into the complexity of the relationship between an institution and the surrounding community, particularly through the lens of service-learning from the perspective of the student and the community partner.

The overarching research question revolves around the several considerations that go into successfully conducting positive service-learning experiences and ways to ensure it serves as a genuine tool for community empowerment. The paper explores the gap between initial objectives and actual outcomes in service-learning initiatives.

The purpose of this study is to unravel the dynamics and problems that may arise in service-learning practices, shedding light on the need for a more sustainable way to support community partners and students. It aims to contribute to the ongoing discourse surrounding service-learning, advocating for a more equitable and sustainable approach to community partnerships.

Methods include literature review on service-learning, personal narrative drawn from firsthand experiences, and interviews with community partner. Together these methods attempt to capture a multifaceted examination of the complexities surrounding service-learning dynamics.

The results of the study reveal the inherent tension between educational objectives and community partner needs within service-learning initiatives. It highlights the importance of dissecting underlying biases and power dynamics in educational practices aimed at community engagement. Though this is a critical examination of personal experiences, this study contributes to the ongoing conversation surrounding the potential to transform service-learning into something fostering more meaningful social change.

Mentor(s): Jessica McMillian, VTEngage, Virginia Tech

Ivan Savelyev
Virginia Tech/Psychology

Walking with a Cellphone: Naturalistic Observations of Social and Emotional Impact

Phone addiction is widespread among college students, with many students using their phone for much of their commute in between classes. Many studies have shown the benefits of being present, and the risks of digital burnout. This naturalistic-observational study seeks to better understand how many college students are using their phone while walking, as well as how several other variables interact with probability of students' phone use. This fits into the study of subjective well-being and positive psychology. Variables being recorded include phone use (not using phone/using phone), social interaction (walking alone/walking with others) and expressed mood (negative affect/neutral affect/positive affect). Behavioral observations have been recorded in three locations, one on the academic side of campus, one on the residential side of campus, and one at a campus crosswalk. These unobtrusive observations utilize event recording to record these variables on students at a specific moment, as they cross a certain boundary. Linear probability tests will be used to find the effect of each binary variable on each binary outcome. Those who are walking with others are predicted to use their phone less than those who are walking alone. Those who are using their phone are expected to express positive affect less than those who are not using their phone. After statistical analysis, this study will provide a greater understanding of which variables affect college student's phone use and ability to be present. Potential implications are a better understanding of phone addiction and potential community interventions to lower it among students.

Mentor(s): Scott Geller, Psychology, Virginia Tech

Anastasia Semenova
Virginia Tech/Psychology
Adyn Teta
Virginia Tech/Criminology

A Student-to-Teacher "Thank You": Effects of Expressing Gratitude on Subjective Well-Being

The Actively Caring for People (AC4P) Movement—www.ac4p.org—integrates humanism and behavioral science (i.e., humanistic behaviorism) to promote the occurrence of interpersonal acts of kindness or prosocial behavior. This ongoing research assessed the impact of expressing interpersonal gratitude on various mood states of students after they delivered a customized thank-you card (TYC) to the instructor of their university class. As a benefactor of personal gratitude, a research student delivered a TYC to his/her instructor after class. The benefactor, as well as a second randomly selected student in the class (i.e., in a Control group), completed a mood survey before and after the lecture. The survey employed a Likert scale to assess 19 mood states (e.g., vulnerability, confidence, interest, and happiness) concerning one's current emotional feelings, evaluating each mood state from 1 (Untrue) to 10 (True).

The TYC included a section for the benefactors to express personal words of appreciation to their professor/instructor. Qualitative analysis revealed uniformly positive emotions from all instructors and from each of the 64 participants who delivered a TYC. The quantitative analysis demonstrated a significant 36% increase in the students' overall positive mood states, after delivering a TYC to their professor/instructor, compared to the control group that showed no significant change in the mood states assessed.

The results of this study support the notion that expressing interpersonal gratitude can enhance a person's subjective well-being (SWB) across multiple mood states. This study also highlights the disturbing lack of interpersonal expressions of gratitude on our university campus, and the need to design and implement interventions to increase occurrences of interpersonal gratitude expressions as an evidence-based strategy for enhancing SWB.

Thus, this research accentuates the significance of gratitude for the enhancement of interpersonal relationships and SWB, as well as the application of humanistic behaviorism to cultivate an AC4P culture.

Mentor(s): Scott Geller, Psychology, Virginia Tech
Jack Wardale, Psychology, Virginia Tech

Anastasia Semenova
Virginia Tech/Psychology
Ivan Savelyev
Virginia Tech/Psychology
Caroline DeDecker
Virginia Tech/Psychology

Personal Identity Influence on the Perception of Misogyny in Social Media

Hatred directed towards women continues to be an issue in online spaces, and misogynistic content is continuously broadcast to young children on short-form entertainment platforms such as TikTok.

This study aims to investigate the difference between males' and females' perceptions of intensity of misogynistic content, as well as their understanding of what misogyny is, and which personal identity factors contribute to these outcomes. This study explores how socialization and humor perception influence individuals' perceptions of misogyny in digital content by including a series of demographic questions to assess how socialization may influence perceptions of misogyny.

The survey includes preliminary demographic questions including age, gender, relationship status, and hometown. Participants will view a series of 15-second TikTok videos sorted into four distinct categories determined through factor analysis from the initial study: women's worth, feminism, gender-based humor, and control videos. For each video, participants are asked to rate the video on level of intensity of misogyny on a Likert 10-point scale, whether they think it was intended as a joke, and how funny they found it to be.

By analyzing these factors, the study aims to provide deeper insight into the gender difference in perception of discrimination against women online. This research is crucial for developing informed interventions and strategies to address this pervasive issue.

Mentor(s): Scott Geller, Psychology, Virginia Tech
Jack Wardale, PhD Candidate, Psychology, Virginia Tech

Caila Serrano
Virginia Tech/Biological Sciences

The Rocky Road: Projecting the climate change impacts on Asplenium trichomanes using ecological niche modeling

Climate change has impacted the geographic ranges of many species because of changes in temperature and precipitation in their habitats. This greatly affects plants that require cool and damp habitats, such as the maidenhair spleenwort, Asplenium trichomanes. There are two subspecies of maidenhair spleenwort in North America, A. tri. ssp. trichomanes and A. tri. ssp. quadrivalens. These subspecies look very similar and can most easily be differentiated by their spore size. They also overlap in their ranges; however, A. tri. ssp. trichomanes is more prevalent in the south while A. tri. ssp. quadrivalens is more prevalent in the north. We measured spores from herbarium specimens and field collections to identify samples to subspecies. As a leptosporangiate fern, A. trichomanes uses wind dispersal and can potentially disperse long distances. This theoretical ability may not be relevant under real-world conditions, so we evaluated past climate shifts for evidence of this behavior. We made an Ecological Niche Models (ENM) of suitable habitat under present-day conditions. We projected the present-day models to the Last Glacial Maximum's (LGM) climatic conditions to evaluate if large-range shifts have occurred in the past. We also projected the models to future conditions corresponding to different carbon emission scenarios to assess future conservation needs. We hypothesize that future shifts in available habitat will be greater than the ferns' ability to adjust based on the LGM.

Mentor(s): Jordan Metzgar, Biological Sciences, Virginia Tech

Benjamin Shettel
Virginia Tech/Biological Sciences

Trichoplusia ni herbivory pressure on crop domestication: Exploring the yield-defense trade-offs in Brassica rapa

The health and production of agricultural plants depend on both increased yield and sufficient resistance against insects. Modern breeding methods frequently select plants in controlled environments resulting in high yields under optimal conditions. However, with climate change and increased interest in organic, no-spray agriculture, crops are often grown in suboptimal conditions. There is an increased need for both high-yield and high-resistant crop plants. Globally, rapeseed (Brassica napus and B. rapa) are of the most important oilseed crops. The model plant, B. rapa Fast Plant from Wisconsin Fast Plants®, have been effectively utilized to study pollination selection under herbivory pressure in the scientific literature, making it an ideal study system to determine the defense-yield trade-offs under selective pressure. I predict it possible to develop high-yielding crops with increased insect resistance by selecting plants for yield while under herbivore pressure. I will attempt to support this by measuring defense and yield in a specific generation of experimentally domesticated Brassica rapa fast plants. Defense will be measured by average trichomes produced, while yield will be measured by average seed oil produced. I expect that results from this project will benefit growers by providing new information to develop crops that will combine high yield with improved herbivore resistance.

Mentor(s): Susan Whitehead, Department of Biological Sciences, Virginia Tech

Emma Simons
Virginia Tech/Psychology

Prevalence of Traumatic Events and Associations with Anxiety and Depression Symptoms Among Children and Adolescents

Experiencing trauma is common during childhood, with over two-thirds of children experiencing at least one traumatic event before age 16. Exposure to trauma causes long-lasting negative impacts on mental health, with many survivors later experiencing anxiety and depression. As such, this study examined the prevalence and association of traumatic events with anxiety and depression symptoms in youth. Additionally, it explored whether these associations differ depending on age and biological sex.

Participants included a community sample of 65 children and adolescents (M=11.6; 58.5% female; 90.8% White). The self-reported Child and Adolescent Trauma Screen (CATS) assessed psychological trauma symptoms associated with experiencing different traumatic events. Parent and child report on the Behavioral Assessment System for Children, Third Edition were used to assess anxiety and depression symptoms.

Consistent with past findings, 67.7% endorsed at least one traumatic event, with 32.3% of the sample falling in the clinical range for the CATS. Children aged 8-11 years reported more trauma symptoms than adolescents aged 12-15 years; no difference was found based on biological sex. Surprisingly, the CATS total score did not significantly predict anxiety or depression symptoms, and neither age nor sex significantly moderated the association between psychological trauma and anxiety or depression (ps>.28).

Lack of findings may be explained by the CATS collapsing across types of trauma (e.g., sexual abuse, being in car accident) and not taking into consideration the recency of trauma, in addition to our sample being predominately White and middle-to-upper-middle class. This poster will discuss future directions for research.

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

Jaime Simson
Virginia Tech/Biochemistry

Wheat-ness the Change: Sowing the Seeds of Regeneration

Can elite cultivars of wheat be regenerated?

Global agriculture faces multifaceted challenges such as climate change, decrease in farmable land, and biodiversity loss, that exacerbates global food insecurity. In 2020 to 2021, 30% of the world lacked access to adequate food. Bioengineered improvement of crops is essential to ensuring food security and helping farmers resolve modern farming problems. Wheat is a staple crop around the world and provides over 30% of all calories consumed by the world population. The regeneration process involves starting with sterilizing seeds, cutting a tissue section and putting it on media that will grow undifferentiated cells. These undifferentiated cells will then be dissected and put on new media every two weeks until roots and shoots are formed, and the plant can be transferred to soil. We have run multiples tests such as; best tissue section to be cut, different sterilization techniques, varying incubation periods, and any observable differences in strains. Analysis involves: comparing regen efficiencies between varieties, tissue sections, and incubation time. Tissue culture also is stressful to plants which can lead to genome duplications. Thus, we plan on quantifying changes in chromosome number in the regenerants relative to the parent plants. We plan on using a one-way ANOVA among other statistical tools to identify significant differences in each experimental condition.

Mentor(s): Bastiaan Bargmann, SPES, Virginia Tech

Analis Smith
Virginia Tech/Biological Sciences

fsr as a selectable marker in sulfite sensitive methanogens

Sulfite is generally toxic to methanogens due to its inhibitory effects on methanogenesis, the only energy source for these strictly anaerobic archaea. Methanocaldococcus jannaschii, an ancient hyperthermophilic archaeon that inhabits deep sea hydrothermal vents, is not only resistant to sulfite, but can also use it as a sulfur source. This ability is due to a novel F420-dependent sulfite reductase (Fsr), encoded by the fsr gene. Most methanogens do not have fsr and therefore, it could act as a selectable marker for genetic analysis in these organisms. To showcase this utility, we have developed shuttle vectors that allow the use of fsr as selectable marker and sulfite as selection agent for a mesophilic and sulfite sensitive methanogen, Methanococcus maripaludis.

Mentor(s): Biswarup Mukhopadhyay, Department of Biochemistry, Virginia Tech

Annabelle Smith
Virginia Tech/Human Development
Mayzie McCall
Virginia Tech/Human Development
Faith Turner
Virginia Tech/Human Development

The Role of Parent Emotion Coaching and Emotion Dismissing in Child Emotion Regulation

Children's ability to control their emotions, labelled emotion regulation, has been associated with more positive development (Bariola et al., 2011). Gottman et al. (1996) suggested that children with better emotion regulation have parents who provide emotion coaching, which is when parents provide guidance in emotional awareness and how to deal with emotion. Parental emotion dismissing, however, is when parents show disregard for children's emotions. Children who receive more emotion coaching, and less emotion dismissing, from their parents have a better awareness of emotions from situation to situation and develop resiliency and problem solving in social situations (Gottman et al. 1996). Specifically, Gottman et al. explained that children whose parents used emotion coaching and not emotion dismissing should be better able to regulate their emotions. Therefore, we hypothesize that higher levels of parental emotion coaching and lower levels of emotion dismissing would be associated with higher levels of child emotion regulation. We examined our hypotheses in a sample of 115 parent-child dyads when children were 6-8 years old. Child emotion regulation was observed during a frustration task, where children tried to draw a perfect green star. Parental emotion coaching and dismissing was observed when parents discussed with children a time when they were happy and another time when they were upset. Parents also self-reported on their emotion coaching and emotion dismissing behaviors. Our findings will be discussed in relation to supporting parenting behaviors to improve children's emotion regulation, which has implications for many aspects of children's optimal development.

Mentor(s): Cynthia Smith, Human Development and Family Science, Virginia Tech
Meredith Atanasio, Department of Human Development and Family Science, Virginia Tech

Rebekah Smith
Virginia Tech/Biological Sciences

Assessing the Role of Nik-/- on Neutrophil and Eosinophil Plasticity in a Murine Model of Hypereosinophilic Syndrome

The noncanonical NF-kB signaling pathway is involved in hematopoiesis, lymphoid organ development, and inflammatory signaling pathways. Mice lacking NIK, a regulatory protein in this pathway, develop an over production of eosinophils, a white blood cell (WBC) involved in the innate immune system. A signaling molecule important for the function and development of eosinophils is Interleukin-5 (IL-5). It was previously hypothesized that the development of this disease in mice was directly related to the pathway's effect on T-helper 2 cells, a producer of IL-5. Yet, through previous data, we have shown that the microenvironment plays a significant role in the maturation and proliferation of eosinophils. In addition, we have identified populations of plastic granulocytes with mixed eosinophilic and neutrophilic surface markers through flow cytometric analysis. We hypothesize that plasticity in neutrophils, driven by IL-5 in the cell microenvironment, may contribute to the increase in eosinophils seen in Nik-/- mice. To evaluate this, we extracted bone marrow from wildtype and Nik-/- mice and used a positive magnetic bead separation technique to isolate a population of CD11b+ cells. We compared the cell count and morphology of wildtype and Nik-/- samples on days 0 and 2. While preliminary results showed limited changes in eosinophil and neutrophil populations after development, I plan to continue examining plasticity further in more specific atypical eosinophil and neutrophil populations using flow cytometry. I would also like to examine the potential roles of other cytokines in the development of under characterized granulocyte populations.

Mentor(s): Irving Allen, Biomedical Sciences and Pathobiology, Virginia Tech

Savannah Smith
Virginia Tech/Psychology
Nawal Gaal
Virginia Tech/Psychology

The Art of Appreciation: Exploring Gratitude Expression in Romantic Relationships

This research seeks to provide a multifaceted understanding of the intricate dynamics involved in improving relationship satisfaction in order to promote healthier relationships. This study aims to investigate the relationship between perceived gratitude expression and its effects on romantic relationship satisfaction among college students. A cohort of 100-200 undergraduate students at Virginia Polytechnic and State University will complete questionnaires from the Couples Satisfaction Index and the Expressions of Gratitude in Relationships Questionnaire to gauge partner-perceived gratitude expression and the subsequent levels of relationship satisfaction. Demographic information will be collected to investigate possible gender differences in perceptions of gratitude expression. Three hypotheses guide this study. 1) Higher levels of partner-perceived gratitude expression will be positively correlated with higher levels of relationship satisfaction. 2) Compared to men, women will report higher levels of perceived gratitude from their partner which will be associated with higher levels of relationship satisfaction. 3) Reported partner-perceived gratitude expression may decrease as relationships last longer while reported relationship satisfaction will remain high. This study contributes to a more comprehensive understanding of the role of gratitude expression in relationships, which may further develop strategies that promote healthier and more satisfying relationships.

Mentor(s): Scott Geller, Psychology, Virginia Tech
Jack Wardale, Psychology, Virginia Tech

Savannah Smith
Virginia Tech/Cognitive and Behavioral Neuroscience
Emma Copening
Virginia Tech/Biological Systems Engineering
Halley Headrick
Virginia Tech/Computational & Systems Neuroscience
Gobran Hanna
Virginia Tech/Electrical Engineering
Felix Lopez
Virginia Tech/Computational and Systems Neuroscience

Translating Electroencephalogram Signals into Mechanical Output with OpenBCI Technology

Our project focuses on using OpenBCI, a tool for brain-computer interfacing, to analyze real-time brain activity via an EEG cap. We aim to bridge the gap for entry-level exploration into the realm of neuroscience and engineering. Direct monitoring of brain signals has the potential to advance our understanding of brain function and facilitate future applications in both the neuroscience and engineering fields, ranging from creating a mind-controlled video game to aiding in addiction therapy. Our research uses OpenBCI's gel-free electrode cap that enables the transmission of brainwave data to a GUI software interface. Through the GUI software, users can analyze brainwave data via various visual aids, including wave graphs, head plots, and spectrograms. To further enhance data interpretation, we have constructed an Arduino circuit with LEDs that light up upon detection of specific brain activity, aiding in real-time visualization and analysis. Our aim is to identify trends and insights within data collected from 30 human subjects. Subsequently, we plan to refine our LED-based system to react specifically to brain activity associated with movement.

Mentor(s): David Gray, Engineering Education, Virginia Tech

Vicky Sobot
Virginia Tech/National Security and Foreign Affairs
Jackson Lawrence
Virginia Tech/Civil Engineering
Aaron Lin
Virginia Tech/Mechanical Engineering
Brysen Knorr
Virginia Tech/Computer Science
Emily Paul
Virginia Tech/undeclared/undecided

Team Malawi Team-Science: Drone/GIS

TEAM Malawi Team-Science is a transdisciplinary collaboration, based upon a community wellness model of health, designed to meet the challenges of resource-limited environments through community based participatory research/design/teaching. As part of the project, our group researched whether or not we could build a drone that would be able to collect water samples from bodies of water, that could then be tested for the parasite Schistosoma haematobium. Our goal for the project was to be able to create a working drone able to collect water samples, as well as add GIS for both tracking and mapping of tested areas. Our project fits into the bigger picture of disease prevention, as our drone works to detect bodies of water that could lead to Schistosoma through its water sample collection. Our methods included brainstorming designs for the drone, drone testing, and looking at various different GIS software's that we could possibly use. So far, our drone is able to fly, and we are current working on our pressure sensor system which will lower tubes down into the water to be able to collect samples. Our anticipated result is to have a smaller scale drone than what we have to now to be able to use and bring to Malawi, as 4 members of our project currently plan to travel to Malawi this summer.

Mentor(s): Andre Muelenaer, Department of Biomedical Engineering and Mechanics, Virginia Tech
Penny Muelenaer, Virginia Tech
Yuba Gautam, Virginia Tech

Sriya Sridhar

Advanced Studies Blacksburg High School Student

Enzymatic Engineering for Enhanced Plastic Degradation in a Novel Plasmid System

Each year, the world produces over 350 million tons of plastic waste, yet only 9% of this waste is able to be recycled. Much of this waste enters the environment as the microplastics MHET and PET, which are non-biodegradable. To promote the degradation of the MHET and PET microplastics, the objective of this project is to utilize the enzymes MHETase and PETase, which break down MHET and PET, to engineer a novel plasmid system to optimize the degradation of MHET and PET. Fine-tuning gene expression is used to alter the expression levels of MHET and PET, to explore the most optimal level for the greatest degradation. To build the plasmid, the MHETase and PETase enzymes are removed from their plasmid backbone and inserted into four plasmid backbones, which vary in the strength of expression of the enzymes. MHETase and PETase are inserted into the new plasmid backbones in replacement of a red fluorescent protein. The new plasmids with the MHETase and PETase enzymes are transformed in an Escherichia coli culture. To analyze the results, the culture is screened for the level of colony multiplication and the absence of the red fluorescent protein, which was present in the original backbone. The plasmid's successful transformation in the E. coli indicates the assembly of a novel plasmid, which could express the MHETase and PETase enzymes at a medium and strong rate, and therefore optimize the levels of plastic digestion to the greatest extent possible.

Mentor(s): Clay Wright, Biological Systems Engineering, Virginia Tech

Katelyn Steide
Virginia Tech/Criminology and International Relations

Building a Brighter Future in Haiti

This research project offers an overview of foreign intervention in Haiti from the late 1980's until the assassination of former president Jovenel Moïse in 2021. The project outlines different forms of international intervention in Haiti to provide a historical context to the sustained conflict and violence in the country. Previous research shows how these interventions have been an impediment to democratization and the internal legitimacy of elected Haitian officials. Current leadership is marred by corruption and well-intentioned leaders have no power to enact change. As a consequence, the emigration of educated citizens in Haiti has prevented the development of future leaders, which contributes to a cycle of failing social services. Using secondary literature and a modern example in Haiti, I hypothesize how investing in higher education in Haiti will create a generation of leaders committed to leading their country. By funding work-study programs to increase access, outreach events to bridge the gap between the university and local community, and the creation of community support networks for students post-graduation, Haitian citizens will have the resources to serve their communities as effective and independent leaders. I conclude by explaining the implications on democracy and peace arguing these types of investments would start a new era of prosperity for Haiti.

Mentor(s): Nikki Lewis, Honors College, Virginia Tech

Madison Stockman
Virginia Tech/Ecological Restoration

Save a Horse, Know Your Pasture: A Guide to Identifying Plants Toxic to Livestock For Virginia

Poisonous plants are responsible for significant economic losses in the agricultural industry at an estimated 250 million dollars lost annually due to livestock fatalities and illness from ingesting toxic plants. Despite ample literature on plant toxicity for livestock, there is a scarcity of region-specific resources tailored to the diverse flora of Virginia. This outreach project aims to fill this gap by providing easily accessible information on livestock plant toxicity to agricultural communities. By reviewing existing scientific literature and data, this project will systematically identify and categorize toxic plant species in Virginia. The resulting guide, formatted as a reusable print calendar, will visually display the seasonality of toxic plants and offer information on species identification, poisoning symptoms, and habitat distribution. Listed plants will be ranked by risk potential to life and property, aiding in prioritizing management. This resource seeks to empower livestock owners by supplying education and strategies to mitigate economic losses associated with plant toxicity, preserve livestock welfare, and secure industry productivity for future generations.

Mentor(s): Jordan Metzgar, Biological Science, Virginia Tech

Erika Strobel
Virginia Tech/Psychology
Oluwatoni Ikhile
Virginia Tech/Psychology

Socioeconomic Status as a Moderator of Relations between Family Conflict and General Psychopathology in the Adolescent Brain Cognitive Development Study

Background: The general psychopathology factor, or the "P-factor", is known as the combination of multiple diagnostic category scores (ex: internalizing and externalizing diagnostic criteria) into one transdiagnostic score. Higher p-factor scores in children and adolescents are positively correlated with higher family conflict, which may be described as a family environment with frequent disagreement and conflict between members and lower levels of familial organization (Flores et al. 2014). Additionally, family conflict is significantly associated with family socioeconomic status, with adolescents living in higher-level SES environments reporting less familial conflict than those in lower-level SES environments (Georgiades et al. 2008; Xiaowei et al.2012). Due to the positive associations between the P-factor and family conflict and SES and family conflict, this project aims to examine family socioeconomic status as a moderator between family conflict and general psychopathology using the ABCD Study database.

Methods: The data used for this project was derived from the Family Environment Scale and the Child Behavior Checklist in the ABCD Study database. The ABCD database includes a sample of more than 11,000 children between the ages of 9 and 10. First, we used a baseline regression model to observe the interaction between family conflict and total combined income and how this may predict p-factor scores. Second, we ran another regression model to observe any 2-year changes of family conflict and income and their predictions of child p-factor scores.

Results: After running the first regression model, we found that family socioeconomic status is a moderator of relations between family conflict and general psychopathology. Secondly, the regression model indicating any changes over two years indicated that socioeconomic status continues to be a significant moderator in the relationship between family conflict and general psychopathology in children.

Conclusions: These results suggest that lower socioeconomic status in families interacts with higher family conflict to increase the likelihood of higher p-factor scores in children.

Mentor(s): Adrienne Romer (Psychology), Jolee Sloss
Department of Psychology
Virginia Tech, Virginia Tech

Samantha Styles
Virginia Tech/Clinical Neuroscience

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June Carter
Virginia Tech/Cognitive & Behavioral Neuroscience

Jimmy Anderson
Virginia Tech/Clinical Neuroscience

Philip Clanor
Virginia Tech/Clinical Neuroscience

Victoria Frank
Virginia Tech/Clinical Neuroscience

Mayali Clary
Virginia Tech/Cognitive & Behavioral Neuroscience

Brianna Woodall
Virginia Tech/Clinical Neuroscience

Kaitlyn Williams
Virginia Tech/Clinical Neuroscience

A Community Approach to Combating the Opioid Epidemic: Integrating Education and Action

The Neuroscience of Drug Addiction course we're currently enrolled in integrates service learning into its curriculum. Our project focused on obtaining Lay Rescuer certification, followed by training to educate community members on responding to opioid overdoses. The severity of the opioid epidemic is evident, with over 100,000 opioid-related overdose deaths in the U.S. in 2021 alone. To address this crisis, the REVIVE! program, part of Virginia's Opioid Overdose and Naloxone Education (OONE) initiative, offers crucial training workshops similar to CPR or First Aid courses. These workshops empower participants to recognize and respond to opioid overdoses, including administering Naloxone. We obtained Lay Rescuer certification and received emergency response kits, including Naloxone, at no cost. The program underscores the crucial role of bystanders in preventing overdose deaths and linking individuals with treatment and recovery services. Opioids, which include prescription pain relievers and illicit substances like heroin and fentanyl, pose a significant overdose risk due to their effects on the body's opioid receptors. Overdoses can occur due to accidental overuse, mixing opioids with other substances, or taking medication meant for others. Armed with our knowledge and training, we engaged fraternity and sorority community members and peers to raise awareness and provide them with the necessary skills and resources to respond effectively in unfortunate circumstances. We'll detail our challenges and key insights through our poster presentation.

Mentor(s): Aparna Shah (School of Neuroscience), Annie Chalmers-Williams, Assistant Director of Substance Misuse Prevention, Hokie Wellness, Virginia Tech, Virginia Tech

Madelyn Swartz
Virginia Tech/Communication

Closing the (Thigh) Gap: Properly Representing Women Through the Introduction of a New Barbie Body Type

The project aims to address the issue of diversity in Barbie dolls and its impact on children's body image. Specifically, it examines the historical background of Barbie, the causes behind the lack of diversity in doll representations, and the effects of these representations on young girls' perceptions of beauty and body ideals. The purpose of this study is to advocate for more realistic representations of women in children's toys, particularly through Barbie dolls. By highlighting the discrepancies between Barbie's traditional body image and real-world body diversity, the project seeks to promote body positivity and combat harmful societal beauty standards perpetuated by unrealistic doll representations. The project utilizes historical research on Barbie's evolution, including the introduction of diverse body types in 2016, to understand the background and context of the issue. It also incorporates findings from psychological studies on body image and doll play to analyze the impact of Barbie's unrealistic body standards on children's self-perception. Finally, the project advocates for the introduction of a new Barbie body mold that accurately reflects the measurements of the average American woman, specifically a size 16. This proposed outcome of the solution aims to promote body diversity, inclusivity, and positive self-image among young girls playing with Barbie dolls. By emphasizing the need for realistic representations in children's toys, the project contributes to broader conversations about societal beauty standards and their impact on childhood development.

Mentor(s): Katie Thomas, School of Communication, Virginia Tech

Calvin Tankersley
Virginia Tech/Geography

Reconstructing Past Environments in Virginia using bat guano stable isotope analyses

Southeastern grasslands in the United States are one of the most endangered categories of terrestrial ecosystems. Today there are remnant grasslands with high endemism and biodiversity suggesting that these ecosystems would have been much larger in the past. Our goal is to determine the relative abundance of grassland habitats in Southwest Virginia since the Pleistocene. This is done through the collection of cores of bat guano from several limestone caves, including Bullfrog and Pig Hole, both in Giles County. We segmented each core into 1 cm intervals and radiocarbon dated five samples per core. We conducted carbon and nitrogen isotope analyses, which serve as proxies for past vegetation and precipitation. Finally, a micro charcoal analysis will be conducted to measure past fire frequency. The 50 cm core from Bullfrog Cave dates to 34,300 cal years BP at the base and 26,200 cal years BP at the top. The 170 cm core from Pig Hole is much younger, dating to 5320 cal years BP at the base and 1195 cal years BP at the surface. Carbon isotope data from Bullfrog Cave (values ranging from -25.4‰ to -26.8 ‰) indicate that the area around Bullfrog Cave was forested for thousands of years and did not support extensive grasslands during the Pleistocene era. In contrast, carbon isotope data from Pig Hole Cave (values ranging from -24.3 to -27.5 ‰) show a significant decline in grassland habitat toward the present to less than 5% grassland (as is true today) from ~25-30% grassland in the mid-Holocene. These results will help to identify appropriate areas for grassland restoration efforts.

Mentor(s): Rachel Reid, Geoscience, Virginia Tech
Dr. Lisa Kennedy, Geography, Virginia Tech

Chloe Taylor
Virginia Tech/Sustainable Biomaterials

Inclusion Complex Technologies to Improve Bioplastic Thermal Stability

This study investigates the effect of using ethyl acetate (EA) and dichloromethane (DCM) as solvents for PHA-β-CD inclusion complex formation. Polyhydroxyalkanoates (PHAs) are naturally occurring polyesters synthesized by microbes and can be degraded in various environmental conditions, including ocean conditions. However, industrial applications of bioplastics such as PHAs are limited by poor thermal stability. The formation of polymer-cyclodextrin (CD) inclusion complexes (ICs) can modify the crystalline structure and thereby improve the thermal stability of polymers due to the new characteristics derived from functional moiety of CD. The use of different organic solvents can influence the formation of the IC, thus influencing its thermal and physiochemical properties. Various analytical techniques, including thermogravimetric analysis (TGA), Fourier transform infrared spectroscopy (FTIR), and differential scanning calorimetry (DSC), were employed to characterize compounds formed at each step of the reaction and isolation process. Both EA and DCM based ICs demonstrate higher onset temperature of weight change in thermal analysis, indicating improved thermal properties. Current results indicate that films with 5% EA based IC have highest thermal stability, with an increase in onset temperature of weight change from 243.8 °C to 281.8 °C. Next steps include identification of an optimized procedure for IC formation and isolation, especially pertaining to solvent choice. These findings will advance bioplastic technology and allow for more widespread adoption of PHAs in packaging applications.

Mentor(s): Young Teck Kim, Sustainable Biomaterials, Virginia Tech

Nadyezhda Taylor
Virginia Tech/Psychology
Zarifa Ali
Virginia Tech/Psychology
Emily Gundel
Virginia Tech/Psychology
Alejandra Granados Gomez
Virginia Tech/Biology

Well-being and Academic Performance: How Should College Academics Consider Seligman's PERMA Model

This longitudinal study aims to look at trends over a semester of psychology students' exam scores, GPA, and their self-reported PERMA levels. The PERMA model was created in 2012 by positive psychologist Dr. Martin Seligman to conceptualize the main factors that contribute to subjective well-being. PERMA stands for positive emotion, engagement, relationships, meaning, and accomplishments/achievements. Through cross-sectional analysis, the data collected from students about their most recent exam score, GPA from last semester, major, demographics, and their self-reported survey responses on their PERMA dimensions is analyzed to show which dimensions have higher correlation to higher levels of academic performance and vice versa. The data analysis also includes looking at the PERMA model as a whole and its relationship with academic performance. The preliminary data was collected in October of 2023 from a sample size of 30 undergraduate students at Virginia Tech. The preliminary data has provided more insight on the future of the rest of the study. This preliminary data has shown that relationships have the largest positive correlation with current in-major GPA, overall GPA, and Spring 2023 GPA, with the greatest difference from other dimensions seen in overall GPA, as well as statistical significance in overall GPA. Upcoming data collection is scheduled to complete by mid April, with our hypothesis being that the relationships dimension will continue to show the highest correlation between academic performance.

Mentor(s): E. Scott Geller, Psychology, Virginia Tech

Nolan Taylor
Virginia Tech/Packaging Systems and Design

Analyzing the financial implications of unsustainable facility operations

Background: We visited three RUI assisted living locations and sorted through their waste and took equipment inventory of all electrical appliances. We were sent utilities data on waste hauling, electricity consumption, and natural gas consumption. Recommendations were made on how to save on costs and improve sustainability. This project focused on analyzing and improving the operational sustainability and costs of the facilities by using annual electricity consumption, natural gas consumption, and waste generation and hauling patterns.

Summarized Methods: Invoices for waste hauling, electricity consumption, and natural gas consumption over a multi-year period were obtained for three case-study residential communities. Important data were compiled and analyzed to identify areas of cost inefficiencies and areas for improvement. materials that should be diverted from waste to recycling or compost to reduce the waste being hauled and increase the diversion of recyclable or compostable materials.

Important Findings: Payments should be made on time. Composting costs the least and should be prioritized to fill with food and limit the waste, which is most expensive, which accounted for 40% of the total weight and food waste was discovered through sorting. Optimizing portion sizes would be beneficial. Each disposal container should be filled efficiently to cut costs. To reduce the high usage of electricity, one large refrigerator per room is not necessary due to the dining options available for the residents.

Impact of this study: This is aimed at informing RUI of certain tendencies or behaviors that could be improved to reduce costs, energy and material usage.

Mentor(s): Jennifer Russell, SBIO, Virginia Tech

Brian Tea
Virginia Tech/Sustainable Biomaterials

Evaluation of single-use cutlery degradation in a home composting environment

The long-term sustainability of our society requires a transition from the current take-make-dispose economy to a circular economy. This means a shift away from non-biodegradable plastics that accumulate in landfills to plastics that can be decomposed in an industrial or even backyard composting operation. This project will use single-use cutlery as an example product that could be made from biodegradable plastic. Currently, most single-use consumer cutlery is made of polystyrene (PS), a petroleum-based polymer with limited biodegradability. However, cutlery made with biodegradable plastics, such as polylactic acid (PLA), may be sustainable alternatives. Eastman Chemical Company in Kingsport, TN, has developed a new biodegradable plastic, AventaTM, made from cellulose acetate, which has various potential applications. In this study, the biodegradation of forks made of different materials was studied, including PS, PLA, and cellulose acetate. Food waste was collected from a Virginia Tech dining hall and mixed with leaves, twigs, and dried grass to create a homogeneous compost mixture. Additionally, a Lomi Bloom provided by Pela Case Corporation was used as a pretreatment method before adding the cutlery to the composting tumblers. The experiment is ongoing. It is anticipated that Aventa will have better biodegradability than PLA and PS. Additional planned measurements of the compost include temperature, moisture content, pH, and carbon-to-nitrogen ratio.

Mentor(s): Maren Roman, Sustainable Biomaterials, Virginia Tech

Tessa Thibodeau
Virginia Tech/Biological Sciences

Do tire road wear particles (TRWPs) influence the accumulation of metals by Daphnia magna?

Tire wear particles have emerged as a pressing environmental issue as their release in the environment is influenced directly by vehicles and the subsequent wear of tires on roadways. These produced tire wear road particles (TWRPs) can enter freshwater habitats via stormwater runoff. The presence of these particles in freshwater can serve as a physical stressor to organisms as well as introduce chemical stressors from their leachates. Due to the properties of TWRPS, pollutants like metals can bind to their surface, altering their movement and transport and potentially introducing higher concentrations through consumption. Metals in aquatic habitats can come from various sources, such as roadways, degraded infrastructure, and development. Metals can be acutely toxic to organisms when exposed to water. However, the question remains: does the presence of TWRPs reduce surface water concentrations of metals, or can they inadvertently increase accumulation when organisms consume TWRPs with metals sorbed to their surface? Here, we investigate three metals (aluminum, cadmium, and arsenic) and determine whether metal concentrations in daphnia differ when co-exposed or not. Understanding the role TWRPs have on metals' fate can help in designing relevant experiments to address the risk associated with co-pollutants in freshwater.

Mentor(s): Austin Gray, Biology, Virginia Tech

Markius Thomas
Virginia Tech/Public Relations

The Ethical Implications of Generative AI in Strategic Communications

Strategic communication encompasses various industries such as public relations, advertising, and digital media, all of which rely heavily on trust as a fundamental aspect of their profession. Despite the gradual integration of Artificial Intelligence (AI) into these industries, professionals express both reluctance and interest in acquiring proficiency in its usage. The current absence of defined regulations surrounding AI in communications related fields contrasts with persistent calls for regulatory frameworks. Consequently, industry leaders navigate loosely defined ethical standards that inadequately address AI's technological advancements. The focus of the proposed study is an qualitative analysis of diverse industry sources to explore ethical dilemmas of AI in today's workplace. It emphasizes the significance of transparency and accountability in the application of generative AI within strategic communication. The findings contribute to the formulation of broad guidelines for practitioners, offer a case study for educational purposes, and propose minor amendments to enhance the relevance of the Public Relations Society of America (PRSA) Code of Ethics regarding AI usage.

Mentor(s): Stephanie Lewis, Honors College, Virginia Tech

Teresa Thornton

Virginia Tech/Environmental Economics, Management, and Policy

Schistosomiasis Mapping for prevention, education, and economic growth

Schistosomiasis is a waterborne, tropical parasitic disease prevalent in Sub-Saharan Africa. Water bodies in Malawi are used for agricultural income, play, sanitation, and domestic utility. Fishers, farmers, and children in Malawi are heavily affected by this disease as it manifests into organ infections and decreases GDP. Schistosomiasis detection is crucial for preventing illnesses and increasing healthy agricultural yields. However, Schistosomiasis is hard to detect using simple observations, so testing devices are crucial for prevention. One method for detection is by using a drone to collect water samples for contactless collection. Once the samples are collected, coordinates of schistosomiasis will be implemented using GIS. Interactive coordinates are essential for healthcare centers, agricultural communities, and families to know where they can go and prevent the burden of schistosomiasis. The interactive coordinates will be used to educate people of Malawi on how Schistosomiasis manifests into the body. Drones are also an innovative avenue towards providing medical care in remote and hard to reach areas. The drone will be deployed in Malawi waterbodies in mid-May.

Mentor(s): Any Muelenaer, Biomedical Engineering, Virginia Tech

Kennetria Torain
Virginia Tech/Psychology
Sarah Nadasy
Virginia Tech/Psychology
Ashtyn Hall
Virginia Tech/Psychology
Ivy Osafo
Virginia Tech/Biochemistry

Temperament Predicts Receptive and Expressive Language Skills in Two-Year-Olds in Different Ways Depending on Gender

Temperament is a complex socioemotional construct contributing to development in important ways. In general, temperament refers to behavioral and emotional reactivity of a child in different situations. Past studies have found that in general, toddlers with more positive affective dispositions show advantages in early language skills. Here, we focused on other aspects of temperament: (1) surgency, and (2) effortful control. Surgency (SUR) is high levels of activity, sociability, and approach behaviors. Toddlers high in SUR are described as outgoing, energetic, and extraverted. Effortful control (EC) is the ability to regulate one's emotions, behaviors, and attention in an adaptive manner. Toddlers who exhibit high levels of EC adapt to situational demands and demonstrate the capacity to inhibit impulsive responses, maintaining attention on tasks while managing their emotions.

We collected temperament via maternal report using the Rothbart and receptive/expressive vocabulary using the MCDI W&S for 55 2-year-olds (31 males, 24 females). Multiple regressions were used to examine the ability of surgency and effortful control to predict expressive vocabulary. For girls, SUR significantly predicted receptive vocabulary (R^2=.47; p=.02) but neither SUR nor EC predicted their expressive vocabulary (all ps > .05). For boys, SUR predicted their expressive vocabulary (R^2=.52; p=.03) but EC significantly predicted receptive vocabulary (R^2=.48; p=.04). These interesting differences in predictors of language skills suggest that girls who are higher in sociability understand more words and boys higher in good self-regulation and control understand more words. In terms of what toddlers say, boys who are more sociable speak more words.

Mentor(s): Robin Panneton, Psychology, Virginia Tech

Keegan Trubenbach
Virginia Tech/Civil Engineering

The Impact of Adsorption Materials for Passive Sampling of Aquifer Microbes

Technologies such as managed aquifer recharge (MAR) and bioremediation promise to play an influential role in addressing water storage and water quality concerns that comes with the ever-increasing demand for water. There is a growing need to monitor the changes in microbial communities within aquifers as they play a crucial role in water quality and the overall health of groundwater ecosystems. Passive samplers are a promising tool to monitor microbes in a manner that represents their in-situ state within an area of study. However, no prior published study has reported a comparative summary of the effectiveness of passive sampler media in the context of aquifer microbial ecology. From the proposed setup in the form of a lab-scale continuous loop experiment, our objective is to compare the effectiveness of adsorption materials (sediment, zirconia beads, and sand) in capturing and accurately reflecting the microbial communities present within an aqueous influent. We hypothesize that microbial abundance and diversity differ in the experimental recovery based on the adhesion media used. This research will play a key role in experimental tools needed for MAR risk analysis as it pertains to monitoring microbial community changes.

Mentor(s): Jingqiu Liao, Environmental and Water Resources Engineering, Virginia Tech

Alexander van Marcke de Lummen
Virginia Tech/Sustainable Biomaterials
Kayla Bolen
Virginia Tech/Sustainable Biomaterials
Sree Chakravartula
Virginia Tech/Sustainable Biomaterials

Modeling & Analysis of Electricity and Greenhouse Gas Emissions in the Built Environment: Case Study

The impact of the built environment on climate change is significant, due to the greenhouse gas emissions stemming from energy use. By implementing measures to reduce energy consumption, companies can effectively lower their carbon footprint and simultaneously cut down on utility costs. A thorough analysis of a company's operations, assets, and practices was completed, providing key insight into energy intensive processes. Two methods were integrated as a hybrid approach to assess energy consumption and related emissions insights across three facilities: First, a walkthrough of three facilities was completed to document the major appliances and energy consuming devices/processes at each facility, and their power ratings were into a comprehensive asset list. Based on observed and stated use patterns, annual energy consumption from documented assets was then modeled using a bottom-up approach. In parallel, utility invoices for the previous year were compiled and analyzed to establish top-line electricity consumption patterns. Data were then normalized to allow for comparison across different facilities on the basis of per-unit, per-resident, and per-square foot energy consumption and related emissions, in order to draw appropriate conclusions and offer facility-specific recommendations to the company. By analyzing energy consumption patterns, the team was able to identify peak usage times and suggest strategies to reduce electricity consumption during these periods. The impact of this study can be applied across the three researched facilities, and throughout the company on a national level. These recommendations can be applied outside of these facilities, to other existing ones, or in the planning phase of new facilities.

Mentor(s): Jennifer Russell, Sustainable Biomaterials, Virginia Tech

Bailey Vaughn
Virginia Tech/Psychology
Junwoo Seo
Virginia Tech/CMDA
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Bryce McBain
Virginia Tech/Cognitive and Behavioral Neuroscience
Ilan Litvak
Virginia Tech/Biological Sciences
Rahul Bhamidipati
Virginia Tech/CS
Alia Konold
Virginia Tech/Biochemistry
Monica Khadka
Virginia Tech/Psychology

The Impact of AI on Preschoolers' Math Language Learning

As artificial intelligence (AI) enters our homes through Siri, Alexa, Amazon Echo, and more, studies show that preschoolers can interact and potentially learn from these technological advancements. However, the specifics of their real-world applications remain unknown. This study specifically focused on whether and how AI is an asset to preschoolers by examining its impact focusing on mathematical language learning in early childhood. The study sample included 36 children aged 3 to 5 years old, who completed the study in an average of 13 days (about 2 weeks). The study used a pretest-posttest design, with 2 test sessions and 3 readings of either an AI math book with questions, an AI math book without questions, or an AI non-math book with questions (3 separate conditions) presented between the pretests and posttests sessions. The children also wore a wristband, which monitored certain biometric elements during these sessions. After all sessions were completed, data from the pre and post-tests were analyzed. After controlling for general vocabulary, gender, and age, the results show that the math book without questions showed greater benefit for children with low pre-test scores whereas the math book with questions became increasingly helpful for those with high pretest scores.

Mentor(s): Koeun Choi, Human Development and Family Sciences, Virginia Tech
Caroline Hornburg, Human Development and Family Sciences, Virginia Tech
Shannon Mury, Human Development and Family Sciences, Child Development Center for Learning and Development, Virginia Tech

Ella Vogt
Virginia Tech/Dairy Science
Camille Porter
Virginia Tech/Biochemistry
Hilary Hunt
Virginia Tech/Biochemistry
Savanna Veazey
Virginia Tech/Biochemistry

Comparing Binding Affinities of Carfentanil and Naloxone in the μ-Opioid Receptor

Carfentanil is a synthetic opioid that is much stronger than better-known opioids such as morphine and fentanyl. Due to its high potency and addiction potential, carfentanil overdoses are more common and more deadly. By focusing research on the properties of carfentanil that cause dependency and overdose, such as the binding affinity, countless overdoses and deaths can be prevented in the future. The question being investigated in the experiment is how carfentanil binds to the mu-opioid receptor in the brain in comparison to naloxone, and how effective naloxone is in reversing the effects of a carfentanil overdose. Naloxone, more commonly known as Narcan, is a medication used to reverse an opioid overdose. Using molecular docking techniques, carfentanil was re-docked to the mu-opioid receptor to determine if the binding affinity was more favorable than naloxone. The results demonstrate that carfentanil has a more negative binding affinity than naloxone, indicating that carfentanil is more effective at binding to the mu-opioid receptor. These results pose the questions of whether Narcan can fully reverse the effects of carfentanil, and if the dose of naloxone should be altered to be more effective.

Mentor(s): Anne Brown, University Libraries, Virginia Tech

Kayla Walker
Virginia Tech/Environmental Science
Jessica Rosen
Virginia Tech/Environmental Science
Grace Justice
Virginia Tech/Environmental Science

Differences in Water Quality in Differing Areas of Local Land Usage

Examining the impact of different types of land cover on water chemistry is crucial for maintaining local environmental health, and for guiding future political and developmental decisions. When considering this fact, our group asked the question: how does water chemistry vary across different types of land cover along the Stroubles Creek watershed? The goal of our research was to find patterns showing the relationship between types of land cover and water quality. To determine potential patterns, we used a YSI professional plus water quality probe to measure the temperature, dissolved oxygen, conductivity, pH, and turbidity of six different water sites. The water sites that we tested were forested, agricultural, and urban. The forested sites were Pandapas pond and the Coal Bank. The agricultural sites we tested were Docs and Holtan streams which were right near a cow pasture. Lastly, the urban sites we tested were Stroubles Creek, Duck Pond, and a stream behind an apartment complex. These sites were right near roads and housing. After comparing these terms in our collected data, we found a distinct increase in conductivity and temperature near urban land compared to undeveloped and agricultural land. There was also higher turbidity at the agricultural sites compared to the urban and undeveloped sites. These patterns show us that comparatively, urban areas have the highest identifiable negative impact on water quality. Knowing this information, we can conclude that if additional residential buildings and university infrastructure are implemented in the future, which is very likely, we will see a negative change in water quality within these water systems.

Mentor(s): Temperence Rowell, Director of Orion Living Learning Community, Virginia Tech

Lishu Wang
Advanced Studies Blacksburg High School Student

The Economic Impact of California's Recent Out-Migration on its Neighboring States

Recently, many people have been moving out of California, a state known for its striking politics, often ominous climate, and immensely high taxes. Mostly, these ex-Californians have been going to nearby states, hoping to find better opportunities there. The entry of great numbers of people into specific areas often has a great effect on the economic state of such areas. In this paper, the impact of California's massive out-migration on California's border states' economies was examined. Correlational studies of the counties of each of these 3 border states– Arizona, Nevada, and Oregon– were done, examining the effect of the number of movers coming from California on the change in real Gross Domestic Product (GDP) for each county between the years 2014 and 2018. It was found that the movement of Californians into California's bordering states was associated with positive GDP growth in these bordering states, though whether this movement of people was the only factor contributing to the GDP increase is quite dubious, as the link between mover counts and changes in GDP was limited. The conducting of further studies on the impact of California's leaving population on recipients of this population would greatly strengthen the implications of the results produced in this study.

Mentor(s): Jin Xu,Finance, Virginia Tech
Katharine Davis, Blacksburg High School

Jeremy Wang
Virginia Tech/Electric Engineering

Guoyu Sun
Virginia Tech

Yifu Yang
Virginia Tech

Yiyang Wang
Virginia Tech

Yueqi Tao
Virginia Tech

Xinchen Liu
Virginia Tech

VT Minecraft Museum

The Minecraft Museum of Engineering at Virginia Tech was created to provide students with opportunities to explore the various engineering disciplines available to them before committing to a major, through interactive exhibits representing concepts and careers in those disciplines. After several years of experience, research, and assessment of student engagement with the first version, we have reconceptualized the museum as a city, where infrastructure, architecture, and industry capture and demonstrate the various engineering disciplines at Virginia Tech, and how these careers can connect with each other. This research explores a framework for the translation of real-world engineered systems into Minecraft, and then into active learning laboratories. We demonstrate this by developing a functional electrical grid for the new Minecraft City of Engineering, and an accompanying learning activity leveraging a substation. We also discuss Minecraft city planning to support additional infrastructure for interactive and creative activities for the exploration of engineering majors.

Mentor(s): Benjamin Chambers, Engineering Education, Virginia Tech

Kyler Williams

Advanced Studies Blacksburg High School Student

Effects of a 3D Printed Low-Profile Insole on Foot Pressure and Performance During Soccer Movements

Over-the-counter supportive insoles are commonly used by athletes to address various biomechanical issues, including flat feet. However, supportive insoles may have adverse effects on soccer-based agility movement performance speed by being too bulky to allow the foot to function properly. This study aimed to test the effectiveness of an off-the-shelf athletic supportive insole (Superfeet (Superfeet Worldwide, Ferndale, Washington, USA)) and a low-profile supportive insole designed by the researcher (LPI) at supporting the medial-longitudinal-arch of the foot and their effects on performance speed during agility movements. A single participant completed a sprint and slalom using soccer cleats (control), soccer cleats with Superfeet, and soccer cleats with the LPI in a randomized order on two testing days. pedar® (novel electronics, Pittsburg, PA, USA) pressure sensors were placed underneath the participant's foot to measure foot pressure distribution, and a stopwatch measured completion time. The averages and standard deviations of the pressure and completion time data were calculated for each footwear condition and then compared qualitatively. Superfeet generally had a slightly greater completion time than the control and tended to increase pressure under the medial-midfoot region, indicating that Superfeet effectively supports the medial-longitudinal arch. The LPI had completion times similar to the control and appeared not to alter foot pressure, indicating the LPI does not support the medial-longitudinal-arch. However, since this study had only one participant, these results are highly preliminary. Rather, this study provided data on how to improve the LPI and served as a proof of concept for future research seeking to improve supportive insoles for athletes.

Mentor(s): Robin Queen, Granata Lab, Virginia Tech

Christopher Wiscarson
Virginia Tech/Biochemistry
Landon Van Remortel
Virginia Tech/Biochemistry
Jordan Lee
Virginia Tech/Biochemistry
Kathryn Curran
Virginia Tech/Biochemistry

Comparing predicted binding affinities of ceftriaxone and cefotaxime in β-lactamase.

Antimicrobial resistance is a growing concern as medications are rendered ineffective in treating infectious diseases, posing a possible health crisis. β-lactamase has been an important component in the development of bacterial antibiotic resistance. Current methods of circumventing the effects of the β-lactamase involve the third-generation cephalosporin ceftriaxone, which binds to the β-lactamase protein and hinders its ability to bind to other antibiotics. Because antibiotic resistance follows patterns of natural selection, it is crucial to know other effective β-lactamase inhibitors should β-lactamase develop a resistance to ceftriaxone. The current study was designed to answer whether cefotaxime could replace ceftriaxone. Molecular docking was performed to investigate if ceftriaxone could be replaced by cefotaxime, and the free energy affinities were compared. It was found that ceftriaxone had a greater favorability to the binding site of the β-lactamase protein, indicating that cefotaxime would not be as effective in hindering the β-lactamase as ceftriaxone. Additionally, it was found that cefotaxime's β-lactam ring could be cleaved, inhibiting the antibiotic's ability to bind to the β-lactamase. Therefore, cefotaxime would not be a suitable replacement for ceftriaxone. More research is needed to find an equally effective ligand to inhibit the β-lactamase protein.

Mentor(s): Anne Brown, University Libraries, Virginia Tech

Walker Wood
Virginia Tech/Political Science
Caleigh Hampton
Virginia Tech/Human Development

Bidialectal Brains: Profiles of event related potentials in a cross-dialectal listening task in Southern US English speakers

Behavioral studies have established that cross-dialectal communication is typically harder than within-dialect communication. However, not all listeners have a clear, singular own-dialect: they have substantial longer-term exposure to multiple dialects. These listeners' behavior in perception tasks varies, with some researchers positing that they may utilize different listening strategies (e.g., Clopper & Walker 2015). In this study, we seek to understand cross-dialectal listening at the neurocognitive level, by analyzing event-related potential (ERP) through electroencephalography (EEG). We designed an auditory go-no-go task, where participants' brain waves were recorded as they listened to 240 monosyllabic words, 240 monosyllabic nonsense words, and 60 animal words. They were asked to press a button every time they heard an animal word, but our primary interest was on their brain responses to the other real and nonsense words. So far, we have analyzed the results of 23 speakers from Western Pennsylvania (critically non-Southerners) who were recorded at Penn State University and 38 speakers from Southwest Virginia recorded at Virginia Tech and in the town of Abingdon (considering these speakers at least receptively bidialectal). Accent effects for both groups (Southern and non-Southern) can be seen for real words on the P200 and N400, reflecting more effortful processing in both the acoustic-phonetic and lexical-semantic stages for Southern compared to Mainstream accents. We see no differences in nonsense word processing, and together, these findings suggest that the difficulty in normalizing Southern-accented tokens at the acoustic-phonetic level disrupts lexical access later on.

Mentor(s): Abby Walker, English, Virginia Tech

Ela Yirmibesoglu
Virginia Tech/Biology

Novel analysis of jaguar injury potential indicates importance of individual heterogeneity

Apex predators, like jaguars (Panthera onca), play important roles in ecosystems by regulating prey populations. Individual jaguars can be subject to injuries that may affect how they utilize resources, including prey. Camera traps are widely used to monitor large carnivores and can record visual evidence of injuries. Injury frequency could provide insight into the condition of individuals and the entire population. Our goal was to estimate "injury potential" while accounting for the fact that some injuries may be present but go undetected. We define the injury potential as the estimated total injuries an individual could incur during a given survey period. We reviewed 1297 jaguar detections from 2016-2018 in Belize, Central America, and identified 100 unique individuals and detected 139 injuries. To account for imperfect detection of injuries, we used a novel implementation of binomial N-mixture models. Our predictor variables were sex and year, with individuals as a random effect, and number of images for injury detection probability. Our top model included only the individual random effect on injury potential, and only sex on injury detection probability. Estimated injury potentials ranged from 0.76 to 12.32 injuries per individual. Estimated detection probability (per photo, per injury) was 0.04 for males (95% CI 0.03-0.08) and 0.02 for females (95% CI 0.01-0.06). Our modeling approach offers advantages over simpler Poisson regressions and could help identify injury-prone jaguars that may be at greater risk of human-wildlife conflict. These insights can improve management practices and could be applied to other species as well.

Mentor(s): Marcella Kelly, Department of Fish and Wildlife Conservation, Virginia Tech
Robert Nipko, Department of Fish and Wildlife Conservation, Virginia Tech

Ben Yost
Virginia Tech/Systems Biology

Exploration of Antibiotic Binding Patterns in Prokaryotic Ribosomes

Antimicrobial resistance (AMR) is directly responsible for 1.27 million deaths globally and contributes to almost 5 million more deaths per year. The overprescription and incorrect usage of antibiotics has led to a rapid increase of bacterial super-strains and has limited the availability of effective antibiotic treatments. Pleuromutilin-class antibiotics inhibit the peptidyl transferase center (PTC) of prokaryotic ribosomes, presenting a greater challenge for bacterial strains to develop AMR. However, there is limited knowledge on the binding patterns of these antibiotics in the PTC. This work seeks to characterize derivative binding patterns in the PTC and determine exploitable interactions to inform drug synthesis.. Preliminary results indicate that prokaryotic ribosomes exhibited favorable binding triazole derivative compounds with short alkyl extensions capped with a polar group, and showed unfavorable binding of long-chain extensions. One model showed favorable interactions between the triazole derivatives and residues G2044, A2045, C2046, C2431, and A2432. Large alkyl groups docked perpendicular to the short alkyl derivatives and co-crystallized tiamulin. Preliminary results further indicate similar binding patterns present in other tiamulin-inhibited bacteria. The identification of these key residues involved in antibiotic PTC binding will contribute to the synthesis of novel antibiotics, such as bidentates, that are more difficult for prokaryotic organisms to develop AMR against. The further characterization of PTC binding pockets is crucial for the synthesis of new compounds that will slow the spread of AMR.

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fMRI/MRI Presentation and Demonstration and Hokie for a Day and Brain Day Events

The Neuroscience of Drug Addiction course that we are currently enrolled in incorporates service learning. Substance use disorders are at an all-time high, and educating the community is more important now than ever. Our project presentation was a component of two events, Hokie For a Day for students from Falling Branch Elementary School and Brain Day for high school students from Pulaski county. Our goal for both events was to teach public school students about different aspects of the neuroscience underlying addiction. Using a presentation and real-time fMRI demonstration, we aimed to exhibit the similarities and differences between MRI and fMRI and their applications. A task-based demonstration involving risky decision-making, commonly used in studying addiction, was shown alongside real-time functional brain imaging data to observe how brain activity changes during the task. Based on student engagement and the questions they asked, we believe we succeeded in inspiring them to gain a better understanding and interest in neuroscience. As undergraduate students, we found this experience valuable in communicating complex topics in a simple and engaging manner for a broader general audience, an important skill as rising professionals in science. Overall, we think this project accomplished what we set out to do and fit in well with Virginia Tech's motto, "that I may serve".

Mentor(s): Aparna Shah, School of Neuroscience), Virginia Tech

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Focused Ultrasound Modifies Tumor Microenvironment and Improves Systemic Anti-Tumor Immunity During Ablation of Pancreatic Tumors

Pancreatic cancer is a uniquely lethal malignancy that has seen minimal improvement in the 5-year survival rate despite decades of research. Histotripsy is a novel treatment modality that uses focused ultrasound to ablate tumor cells by creating a negative pressure environment during which pulses are delivered to produce acoustic cavitation, lysing cells, and generating acellular homogenate. This instrument is a non-thermal, non-ionizing treatment, equipped with image guided ultrasound for precise tissue targeting. Our hypothesis is that with the ablation of tumor cells and generation of acellular homogenate, this will improve systemic anti-tumor immunity by activating the immune system and cause abscopal like effects with the recognition of metastasized sites. This study was conducted using C57Bl/6 mice with contralateral pancreatic tumors developed in their flanks. Only one of the two tumors present on each mouse was treated and tumor size and immune cell populations were measured for both tumors at several timepoints. Our data suggests that histotripsy treatment of pancreatic tumors is effective in generating an acute abscopal like effect with reduction in both the size of the treated and untreated tumors. Flow cytometry was used to quantify the immune cell populations within each tumor microenvironment identifying significant changes in dendritic cells, macrophages, helper T cells, and cytotoxic T cells. Overall, this data suggests that histotripsy treatment has promising implications for the future of cancer treatment, even with historically resistant malignancies. Moving forward, we aim to evaluate the potential mechanisms of immune cell activation with the hope that these could be modified to create stronger abscopal like effects and offer a greater chance at remission.

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Effect of Ultra-Processed foods on Delay Discounting Rate Among Young Adults

Ultra-Processed Food (UPF) are widely consumed in the US and it is argued that UPFs lead to obesity and poor health outcomes. Meanwhile, Delay Discounting (DD) is a well-validated measure of impulsivity that measures individuals' valuation of future monetary reward versus a smaller, immediate reward. Higher DD is proposed to be associated with impulsive behavior and negative health outcomes. The objective is to measure the association of DD and dietary intake. Here, we used data from an ongoing cross-over RCT, in which participants aged 18-25 went through 2-weeks of UPF and non-UPF diets. Before and after each diet period, participants were asked to complete a 5-trial DD questionnaire, and lnk value was calculated as the natural log of the discounting rate “k”. We hypothesize subjects will have a higher increase of lnk value after the UPF diet period than after non-UPF diet period. An exploratory goal is to determine whether the lnk value can predict behaviors during an ad libitum buffet meal. We have complete DD data from n=13, partial data from n=8, and buffet meal data were collected from 18 participants who completed the study. Mixed effect model was used to assess the time (pre/post) by diet interaction on lnk value. We observed a small increase after the UPF diet (p=0.16), but not after the non-UPF diet. Furthermore, the regression analysis suggests that the lnk value, whether before (p=0.64), after (p=0.58) or the change across (p=0.47) the diet periods, does not significantly predict the ad lib buffet intake in this sample. Previous literature has suggested DD as a potential target for weight loss interventions. Our null results are likely due to the short duration of controlled feeding and the small sample size; however, we are continuing to collect data.

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Exploring the impact of choral group singing on the feelings of choir members and quality of life of persons with dementia and their respective caregivers.

The goals of this study are to increase the interactions between older adults and college students, improve the quality of life for people with dementia and their caregivers, and increase heart variability over baseline for all participants. With the prevalence of dementia on the rise, we want to further research that provides interventions in which persons with dementia can alleviate their symptoms. We aim to decrease the caregiver burden associated with dementia care by creating a positive community outlet to increase quality of life. We hypothesize that all members will experience positive feelings after participating in choir sessions, improve quality of life for people with dementia, and decrease caregiver burden. We also expect an increase in heart rate variability. Participants were recruited from VT news, community flyers, and word of mouth, ranging from 6 years old to 82 years old. Rehearsals occur on Thursdays at the Creativity and Innovation District building, beginning with a socialization period and a pre-questionnaire on mood assessment. Smartwatches were worn during rehearsals to measure heart rate variability, and participants rehearsed 5 songs with provided instruments. Post-rehearsal, participants completed another questionnaire on their current mood. Caregivers were given a burden and quality of life assessment at the beginning of data collection and will receive the same assessment at the end of data collection. We expect the community choir and concert performance to improve positive feelings for all participants due to their participation. Heart rate variability is also expected to increase, indicating a decrease in stress.

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TEAM-Malawi Hydroponics Implementation Plan

One form of controlled environment agriculture is hydroponics, a soilless technique that enables growers to produce yields outside regular growing seasons. Especially in Sub-Saharan Africa, a region with a wet and dry season, the ability of hydroponics systems to produce food year-round gives these systems the potential to address food insecurity and malnutrition in ways traditional agriculture cannot. In resource-limited countries like Malawi, lack of online access to technical information has made the development of the local hydroponics industry slow and challenging. To address these challenges in Malawi, our team has collaborated with colleagues at a non-profit organization, The MakerzSpace, in Blantyre, Malawi, to design and evaluate hydroponics systems and techniques that permit growth of tomatoes outside the typical growing season. Technical aspects of this project include designing an efficient hydroponics system to address malnutrition, developing both a mechanical and electrical water gauge to be used in the system, testing different growing media, and fermenting organic liquid fertilizers from locally available waste. Ultimately, our team aims to partner with the Malawian team as they implement the final designs in schools and hospitals.

Mentor(s): Andy Muelenaer, BEAM, Virginia Tech
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Machine Learning and Morphology Based In-Ovo Sexing of Chickens

The culling of male chicks in the laying hen industry poses ethical and economic challenges. This study investigated the potential of a non-invasive in-ovo sexing method for chicken eggs using morphological analysis and machine learning. Previous research on duck eggs has demonstrated promising results utilizing similar techniques. It was hypothesized that combining morphological measurements of chicken eggs with machine learning algorithms can accurately predict chick sex before hatching. The study involved incubating White Leghorn chicken eggs and imaging them with a custom apparatus before they hatched. The sex of each chick was determined through necropsy. Egg morphology was analyzed using MATLAB to measure geometric features. Four machine learning models were trained and test with five features (length, width, area, eccentricity, and extent) and seven-fold cross-validation. Results showed varying accuracies; notably, the Wide Neural Network algorithm demonstrated a sex prediction accuracy high of 88.9% and average accuracy of 81.5%. These findings present a promising avenue for the development of a non-invasive in-ovo sexing method for chicken eggs. Further optimization of machine learning algorithms and validation on larger sample sizes are warranted to enhance accuracy and reliability. The great potential societal impact of reducing male chick culling underscores the significance of this research.

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The Effect of Mutations in the Active Site of Acetylcholinesterase Impacts Inhibitor Binding

Acetylcholinesterase (AChE) is an enzyme predominantly found in neuromuscular junctions where it breaks down acetylcholine (ACh) into acetic acid and choline. Limiting the function of AChE appears to be helpful in treating Alzheimer's patients to mitigate the underproduction of ACh. The experimental objective of this work is to determine if an alteration of the amino acid in the ligand binding site of AChE will limit the ability of the inhibitor huperzine A to bind. Hup A is a known AChE inhibitor that is a beneficial treatment to symptoms of Alzheimer's Disease (AD). To test this, the polar amino acid Histidine 437 was mutated to Alanine. The mutation to a non-polar amino acid was tested for a measurable effect on the inhibitor's ability to dock into AChE. Molecular docking was then utilized to identify how the alteration of the binding site polarity impacted the distance at which hup A was able to bind to AChE. The results showed that the affinity of the docking ability of hup A decreased by 0.92 kcal/mol. Overall, the results indicated that the alteration of HIS-437 to ALA-437 did not substantially alter the binding affinity of the ligand but altered position. Further research can be done to improve the affinity of hup A within AChE to increase levels of ACh and improve cognitive function in patients with AD.

Mentor(s): Anne Brown, University Libraries, Virginia Tech