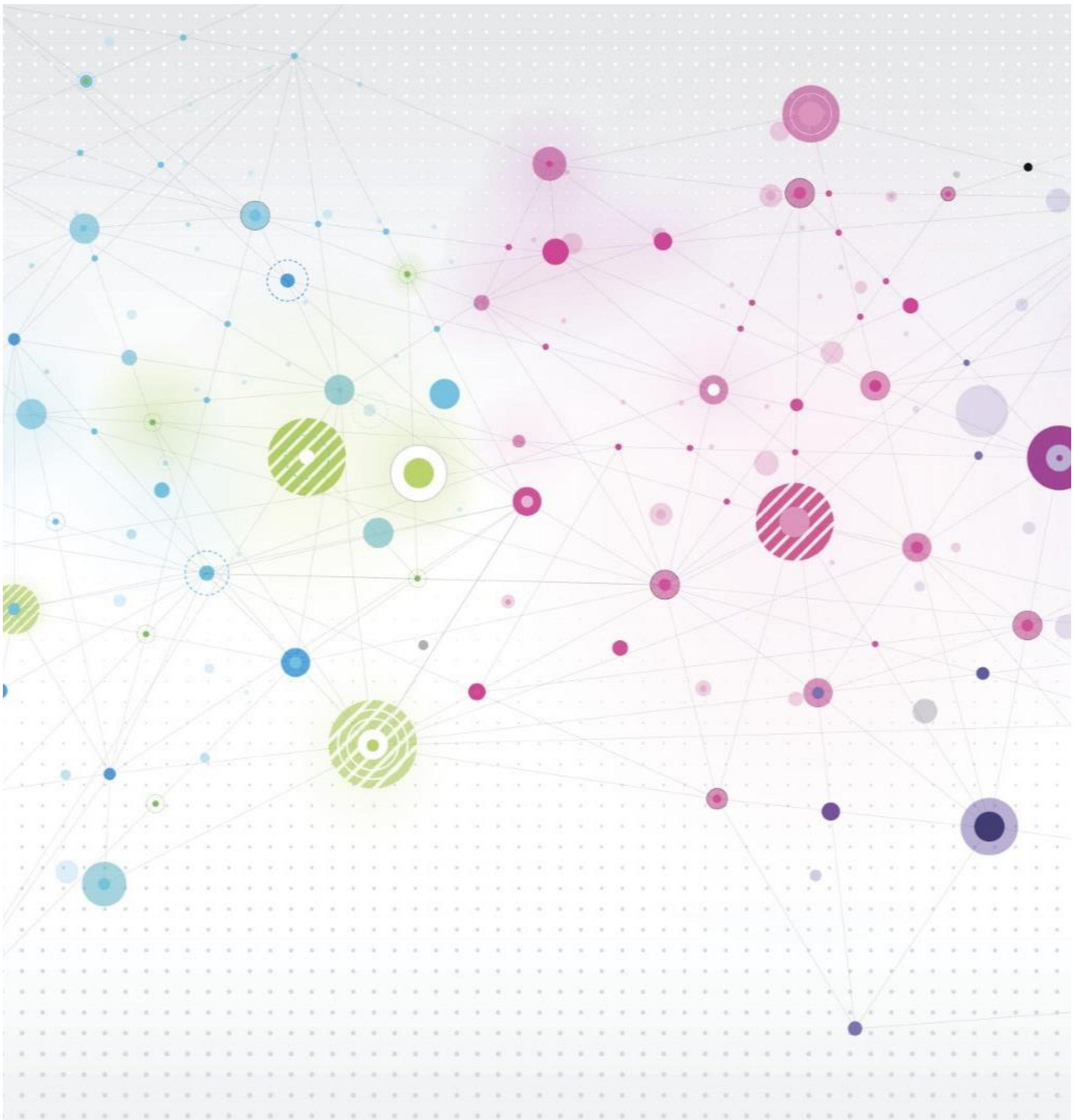
2025

Dennis Dean Undergraduate Research & Creative Scholarship Conference

Office of Undergraduate Research / April 25, 2025



research.undergraduate.vt.edu/symposium

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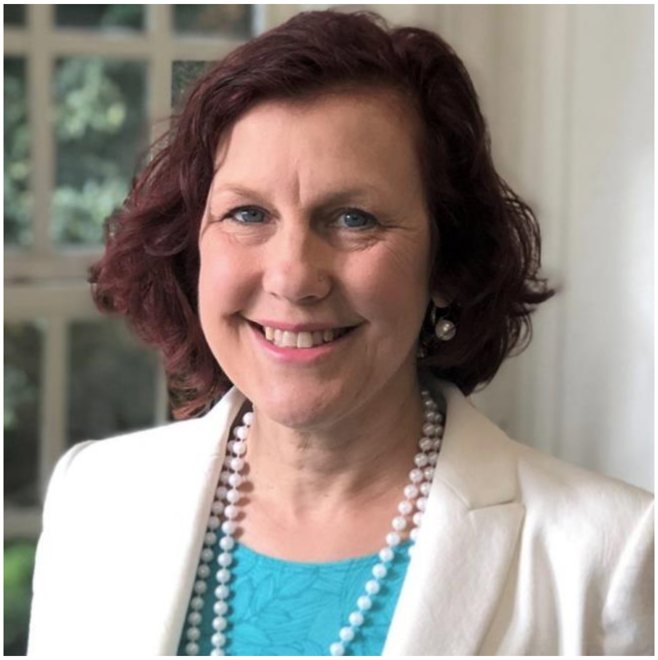


Welcome

Jill C. Sible, Ph.D.

Associate Vice Provost for Undergraduate Education
Professor of Biological Sciences

Welcome to Virginia Tech's 2025 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.

We have a record number of posters this year – 274! Students who participated in service learning will be among our presenters. Thank you for sharing what you have learned with our community partners.

We also welcome 18 local high school students who have engaged in research, many under the mentorship of Virginia Tech faculty. We hope that your experience has sparked a passion for research and a lifetime of curiosity.

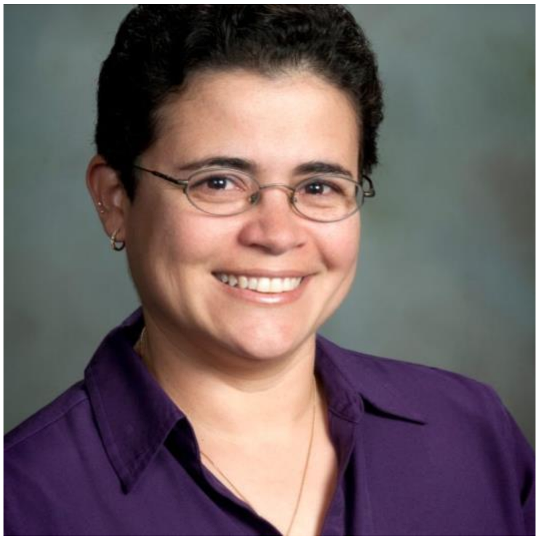
Many thanks to Keri Swaby, Nicole Bottass, Truitt Elliott, and the entire the entire team in the Office of Undergraduate Research for hosting this event and supporting our undergraduate researchers throughout the year.

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 eleventh 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 531 students, including four visiting undergraduates representing the Universities of Mississippi, Illinois, and Toledo, and the US Naval Academy, and 18 students from Blacksburg High School, who will present 274 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.

In addition to sharing their work with the community, students will also be competing for 10 different presentation awards. A special thanks to the Institutes and Colleges who sponsor and facilitate these awards and to the judges who are graciously giving their time to review, listen, and provide valuable feedback to our presenters.

We are excited to introduce the first Undergraduate Nutshell Games, a special session featuring students who completed the inaugural Theatre STEM program, a partnership between FLSI, the OUR, Center for Communicating Science, and School of Performing Arts. STEM undergraduate researchers will share their exciting research projects in an accessible and fun way in just 90 seconds! We hope you can join us for this exciting session.

The conference is only possible through the incredible hard work of our Office Coordinator, Nicole Bottass, OUR Assistant Director, Truitt Elliott, and OUR faculty fellow, Dr. Debby Good from HNFE; 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 2025 ACC Meeting of the Minds (ACC MOM) was held at in University of Pittsburg. The scheduled conference dates were March 28-30, 2025. 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.

Thiviya Karuppasamy, Microbiology and Public Health
An investigation of the Effect of Human Touch on the Taxonomic Composition of the Lettuce Leaf Microbiome
Dr. Boris Vinatzer

Caleigh Hampton, Human Development
Capturing the Sound od SWVA: Investigating Rates of/ay/ Monophthongization Usage
Dr. Abby Walker

Abigail Detloff, Microbiology
Potential Protein-Protein Interactions on the Bacillus Spore Inner Membrane
Dr. David Popham

Raaj Aggarwal, History and Social Science Education
Global Illiteracy in the World's Most Powerful Country: Responding to the United States' Role in the World through Critical Global Citizenship Education
Dr. Rachelle Kuehl

Elizabeth Eroshenko, Environmental Science
Indicator Bacterium Survival Peaks in Brackish Waters
Dr. Brian Badgley and Dr. Meredith Steele

NCUR

The 2025 National Conference on Undergraduate Research (NCUR) was held in Pittsburg, Pennsylvania. The scheduled conference dates were April 7-19, 2025. 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.

OUR Ambassadors

Office of Scholarly Integrity and Research Compliance

Translational Biology, Medicine, and Health

Virginia Tech Graduate School

2024-25 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.

Lily Casteen, Wildlife Conservation, College of Natural Resources and Environment

Faculty Mentor: Dr. Elizabeth Nyboer
American Fisheries Society- Annual Meeting, September 15-19, 2024

Elea-Maria Abisamra, Cognitive and Behavioral Neuroscience, College of Science

Faculty Mentor: Dr. Daniel Capelluto
NOBCChE's 51st Annual Meeting. September 30-October 3, 2024

Suzie Muller, Chemistry, College of Science

Faculty Mentor: Dr. Michael Schulz
ACS Fall 2024. August 18-22, 2024

Teresa Thornton, Environmental Economics, Management, and Policy & Public Health, College of Agriculture and Life Sciences

Faculty Mentor: Dr. Andy Muelenaer
World Food Forum Transformative Research Challenge. October 14-18, 2024

Anastasia Semenova, Psychology, College of Science

Faculty Mentor: Dr. E. S. Geller
APA 2024 Convention. August 8-10, 2024

Ariana Garrasetgui Segarra, Animal and Poultry Sciences, College of Agricultural and Life Sciences

Faculty Mentor: Dr. Jennifer Rainville
Society of Neuroscience. October 5-9, 2024

Meredith DePuy, Industrial and Systems Engineering, College of Engineering
Faculty Mentor: Dr. Kimberly Ellis
INFORMS conference. October 20-23, 2024

Elizabeth Eroshenko, Environmental Science, College of Agriculture and Life Sciences
Faculty Mentor: Dr. John Galbraith
2024 American Society of Agronomy, the Crop Science Society of America, and the Soil Science Society of America International Annual Meeting. November 10-13, 2024

Arnav Khurma, Computer Science, College of Engineering
Faculty Mentor: Dr. Olga Isengildina Massa
UCC (Undergraduate Commodities Competition). October 4-5, 2024

Charlotte Cunningham, Psychology, College of Science
Faculty Mentor: Anastasia Semenova
APS Global Psychological Science Summit Planning Committee, October 23-24, 2024

Sakhi Trivedi, FinTech and Big Data Analytics, Pamplin College of Business
Faculty Mentor: Dr. Olga Isengildina Massa
Undergraduate Commodities Competition. October 4-6, 2024

Jay Rajurkar Mechanical Engineering, College of Engineering
Faculty Mentor: Dr. Olga Isengildina Massa
Undergraduate Commodities Competition. October 4-6, 2024

Ruben Ramirez, Geoscience, College of Science
Faculty Mentor: Dr. Sarah Stamps
SACNAS NDiSTEM Conference. October 31 – November 2, 2024

Erica Liller, Geoscience, College of Natural Resources and Environment
Faculty Mentor: Dr. Josh Starner
Southeastern Division of the American Associates of Geographers, November 23-25, 2024

Shlok Rajeev, FinTech and Big Data Analytics, Pamplin College of Business
Faculty Mentor: Dr. Olga Isengildina Massa
Undergraduate Commodities Competition. October 4-6, 2024

Seth Boehringer, Biochemistry, College of Agriculture and Life Sciences
Faculty Mentor: Dr. Matthew Lazzara
BMES Annual Meeting. October 23-26, 2024

Victoria Tabacchi, Biology, College of Science
Faculty Mentor: Dr. Christopher Arena
BMES. October 23-26, 2024

Vasundhara Gatne, Computer Science, College of Engineering
Faculty Mentor: Dr. Anirudh Prabhu
Annual Meeting of the American Astronomical Society (AAS). January 12-16, 2025

Savaria Parrish, Geoscience, College of Agriculture and Life Sciences
Faculty Mentor: Genaro Suarez
American Astronomical Society Conference. January 12-16, 2025

Keith Morin, Environmental Sciences, College of Science
Faculty Mentor: Dr. Ryan Stewart
ASA, CSSA and SSSA Annual Meeting. November 10-13, 2024

Griffin Paddock, Mathematics and Chemistry, College of Sciences
Faculty Mentor: Dr. Charis Tsikkou
Joint Mathematics Meeting. January 8-11,2025

Abhiram (Simba) Srivastava, Paleobiology/Geobiology option of Geosciences, College of Science
Faculty Mentor: Dr. Sterling Nesbitt
Society for Integrative and Comparative Biology Annual Meeting 2025. January 3-7, 2025

Trisha Naidu, Computational and Systems Neuroscience, College of Science
Faculty Mentor: Dr. Ashley Taylor
National Collegiate Research Conference (NCRC) 2025. January 24-26, 2025

Christina Bujoreanu, Smart and Sustainable Cities, College of Liberal Arts and Human Sciences
Faculty Mentor: Dr. Andre Muelenaer

Consortium of Universities for Global Health. February 20-23,2025

Caleigh Hampton, Human Development, College of Liberal Arts and Human Sciences
Faculty Mentor: Dr. Abby Walker
Southeastern Conference on Linguistics. April 10-12, 2025

Eliza Quesenberry, Professional and Technical Writing, College of Liberal Arts and Human Sciences
Faculty Mentor: Dr. Abby Walker
Southeastern Conference on Linguistics. April 10-12, 2025

Caroline McCormick, English Literature, College of Liberal Arts and Human Sciences
Faculty Mentor: Dr. Abby Walker
Southeastern Conference on Linguistics. April 10-12, 2025

Abby O'Donnell, Biochemistry, College of Liberal Arts and Human Sciences
Faculty Mentor: Dr. Kristopher Hite
2025 ASBMB Annual Meeting. April 12-15,2025

Raskshan Mudumba, Human Nutrition Food and Exercise, College of Agriculture and Life Sciences
Faculty Mentor: Dr. Kristopher Hite
2025 ASBMB Annual Meeting. April 12-15,2025

Ghaleeb Hakim, Mechanical Engineering, College of Engineering
Faculty Mentor: Dr. Matthew Newton
Harvard National Collegiate Conference. (NCRC) January 24-26,2025

Ethan Chi, Grado Department of Industrial and Systems Engineering, College of Engineering
Faculty Mentor: Dr. Nathan Lau
HFES International Symposium on Human Factors and Ergonomics and Health Care. March 30- April 2 ,2025

Yufei Chen, Industrial Systems Engineering, College of Engineering
Faculty Mentor: Dr. Nathan Lau

HFES International Symposium on Human Factors and Ergonomics and Health Care. March 30- April 2 ,2025

Jiacheng Zhao, Computer Science
Faculty Mentor: Dr. Scott McCrickard
The Technical Symposium on Computer Science Education 2025 (SIGCSE TS). February 26- March 1,2025

Louhan Dembele, Public Health
Faculty Mentor: Dr. Andy Muelenaer
Consortium of Universities for Global Health. February 20-23, 2025

Ayah Ali, Mechanical Engineering
Faculty Mentor: Dr. Andy Muelenaer
Consortium of Universities for Global Health. February 20-23, 2025

Office of Undergraduate Research Ambassadors

Annabel Bass (Graduation: Spring 2026)
Sociology – Engineering Education

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

Gaby Carter (Graduation: Spring 2025)
Biological Sciences – Chemistry (plant pathogen interactions and plant biochemistry)

Grayson Ryan (Graduation: Spring 2025)
Architecture – Cognitive neuroscience and the built environment

Hannah Beasey (Graduation: Spring 2026)
Biological Sciences and Microbiology - Brain cancer, T-cell engineering, and fluid flow

Jaden Minnick (Graduation: Spring 2026)
Chemical Engineering & Physics – Nuclear Physics

Jamie Bhan (Graduation: Spring 2025)
Mechanical Engineering – Mechanical Engineering

Lindsay Smith (Graduation: Spring 2026)
Microbiology – Phage drug delivery and gut microbiome research

Makenzie Woolls (Graduate Student)
FBRI – Translational Biology Medicine and Health program at the FBRI campus in Roanoke

Nicole deFoor (Graduate Student)
FBRI – Translational Biology Medicine and Health program at the FBRI campus in Roanoke

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

Raaj Aggarwal (Graduation: Spring 2025)
History and Social Science Education – History of racially restrictive covenant, critical pedagogy

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

Sam Purvis (Graduation: Spring 2025)
Biological Sciences – Leachate toxicity in aquatic ecosystems and microplastics research

Shruthi Ramani (Graduation: Spring 2026)
Political Science – Government and politics with a focus on data science

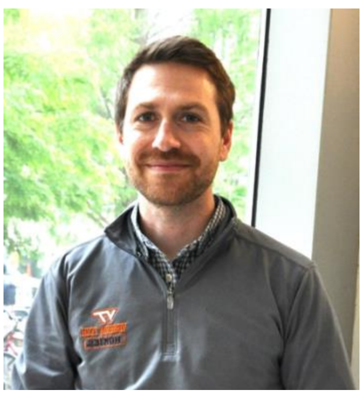
Thiviya Karuppasamy (Graduation: Spring 2026)
Microbiology and Public Health – Plant pathology & environmental, aerosol and plant microorganisms

Zacarya Elbash (Graduation: Spring 2025)
Neuroscience – Clinical Neuroscience (nicotine and alcohol addiction)

2024-25 Outstanding Undergraduate Research Mentor Award

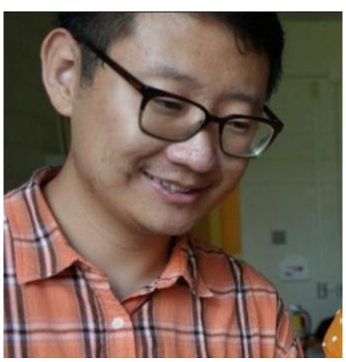
An often overlooked, unrecognized and unrewarded mode of teaching is mentoring undergraduate students in research. Four years ago, the Office of Undergraduate Research launched the Outstanding Undergraduate Research Mentor Award - for a Faculty and a Graduate Student - to recognize the hard work, time,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



Adam Maxwell

The recipient of this year's **Outstanding Undergraduate Research FACULTY Mentor Award is Adam Maxwell, Ph.D., Research Associate Professor in the Department of Biomedical Engineering and Mechanics.** In their five nominations, the students described Dr. Maxwell as supportive, enthusiastic, invests in students' future and sees setbacks as an opportunity of growth.



Shuyu Zhang

The recipient of this year's **Outstanding Undergraduate Research GRADUATE STUDENT Mentor Award is Shuyu Zhang (Biomedical Engineering and Mechanics)**, who received seven nominations. In his nominations, Shuyu was described as patient, dedicated, kind, supportive and goes out of his way to help others.

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
Anne Brown
Caitlin Collins
Yancey Crawford – co-chair
Dennis Dean
Sarah Downer
JP Gannon
Hannah Glisson
Monica Hunter
Iris Jenkins
Carrie Kroehler – co-chair
Stephanie (Nikki) Lewis
Amanda MacDonald
Frank May
Isabel Prochner
Rachel Reid
Meredith Steele
Gillian Su
Pam Van deVord
Abby Walker

Student Members:

Gabrielle Carter
Thiviya Karuppasamy
Brianna Reilly

The Inaugural Undergraduate Nutshell Games

WELCOME TO

THE INAUGURAL UNDERGRADUATE NUTSHELL GAMES

90-second research talks
by Virginia Tech undergraduate students

Part of the Dennis Dean Undergraduate Research and Creative Scholarship Conference

The games were made possible by the Dennis Dean Theatre STEM Program, a collaboration between The Office of Undergraduate Research, the Center for Communicating Science, and VT's theater arts program.

UNDERGRADUATE NUTSHELL GAMES GO FROM 3:25 P.M. - 3:55 P.M.

- *Slammed Into Action: Assessing the Impact of Wave Interactions on High-Speed Planing Vessels;* **Margaret Campbell**; College of Engineering, Department of Aerospace and Ocean Engineering.

- *A Network of Hidden Figures, Accessing History;* **Katelyn Crumpacker**; College of Engineering; Department of Computer Science

- *Up, Down, All Around: Tracking Fetal Movements*; **Tarun Nandamudi**; College of Engineering; Department of Biomedical Engineering and Mechanics.

- *Own Your Home (or Can You?);* **Aryan Palit**; College of Engineering; College of Science; Department of Computer Science; Department of Mathematics

Nutshell Games Respondents

- Gabryella Ashe, local 7th grader
- Carrie Kroehler, Associate Director of the Center for Communicating Science at VT
- Patty Raun, Director of the Center for Communicating Science at VT

Center for Communicating Science
the art of connecting across difference

VIRGINIA TECH.
OFFICE OF UNDERGRADUATE RESEARCH

Conference Schedule & Abstracts

Conference Schedule

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

Primary Presenter Last Name	Presentation Title	Poster Number
Almasri	Neurophysiological Evidence for The Role of Attention on Inhibitory Control During Childhood: A Preliminary Study	1
Anderson	Refining Regeneration & Transformation Techniques in Potato (Solanum tuberosum)	2
Anikis	Urban versus Rural Differences in Microplastic Abundance found in Caddisfly Larvae and Casings	3
Bartz	Evaluating the Impact of Choral Group Singing on Emotions of Choir Members Including Individuals with Dementia and Their Caregivers	4
Beasey	The Impact of Interstitial Fluid Flow on CAR T cell Motility	5
Bishop	Dog Aging Project Grain Free Diet Validation	6
Brick	Mapping Antarctica's Hidden Cryosphere: Predicting Ice Loss Through Subglacial Dynamics and Accelerated Ice Sheet Thinning in a Changing Climate	7
Brown	Quality of life of Leiomyosarcoma survivors: Continued screening for recurrence	8
Bujoreanu	TEAM-Malawi: Addressing Food Insecurity in Africa with Hydroponics	9
Croitoru	Identifying Early Maladaptive Schemas that Associate with Alcohol Use and Problems among Adults in Residential Treatment for Opioid Use Disorder	10
Dammalapati	Challenges Adolescents with Autism Spectrum Disorder Address in Therapy	11
Davidson	Neuroscience in Action: Bridging Policy, Community, and Harm Reduction through Service Learning	12
Eroshenko	Indicator Bacterium Survival Peaks in Brackish Waters	13
Flessa	Phosphorus Dynamics in Intensively Managed Loblolly Pine Stands (P. taeda L.): Insights from Annual Growth Rings	14
Forsythe	Chronic Low Level Stress in Zebrafish	15
Handley	Tsunami Genesis, Risk Reduction, Early Warning Systems, and Evacuation	16
Horton	Questioning the Canonical Mechanisms of Cardiac Automaticity	17

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

Primary Presenter Last Name	Presentation Title	Poster Number
Canan	Characterizing the Effects of Microorganisms on Beer Quality and the Brewing Process	1
Crum	Weller's Wannabe? Investigating Possible Mimicry between Desmognathus orestes and Plethodon welleri	2
Crumpacker	Computer Systems Genome Project: Data and Endpoints Management	3
Deane	The Impact of Alternative Marketing Strategies on the Perception of Shelter Animals.	4
Dodge	Influences on Verb Conjugation in Late Talkers	5
Dreesbach	The effect of secondary metabolite diversity on pathogen evolution	6
Elbash	Effects of GLP-1 agonists in people with obesity during alcohol consumption	7
Endres	Russia's Use of Gendered Disinformation as a Tool of Hybrid Warfare Against the United States	8
Eroshenko	Evaluating the Financial Landscape of Soil Judging Programs	9
Fuller	Team Malawi- Community Based Childcare Centers	10
Gitre	Partying Parulidae: Interspecific Social Networks of Parulidae Warblers in Active Migratory Passage	11
Gross	Influence of Environmental Nicotine Alkaloids on Phyllobates aurotaenia Toxicity	12
Holland	The Relationship Between Heat and Income in Virginia: A Correlational Study	13
Kleponis	"Hey Reddit, I'm worried about my grades. Is this normal?": An exploration of engineering students' discourse around grades and their impact on students	14
Lahmers	Symbiotic Strength: Evaluating Mycorrhizal & Nitrogen-Fixing Influences on Plant Fitness	15
Larkin	Functional Characterization of the Arabidopsis AAP Family Using a Yeast Expression System	16
Louvet Jr	How Regulated are Recreational Fisheries in the Great Lakes?	17
Lowe	Stand Still! Comparing Positive and Negative Reinforcement in Equine Training	18
Macrea, Ian	Repeated Impacts on Cycling Helmet Efficacy	19

Macrea, Ingrid	The Accuracy of an American Sign Language-Recognition Deep Neural Network (Transfer Learning Approach) under Simulated Healthcare Conditions	20
Madison	Exploring Neural Resilience: The Role of Cognitive Reserve in Behavioral and Brain Outcomes Following Cognitive Training	21
Miloszewski	Quantifying Histotripsy Effects on Tendon Integrity	22
Moles	Soil Quality of Worm Compost	23
Montano	The impact of High Deductible Health Plans on lower income populations	24
Ngo	Investigating the Molecular Interactions of Soybean Lectins to Mitigate its Anti-nutritional Effects in Soybean Meal	25
Peloquin	How Accurately Do Owners Remember What They Feed Their Dogs?	26
Polys	Gauging the Cultural Relevance of Bluegrass Lyrics to Central Appalachia via Linguistic Analysis	27
Probst	The Role of Headphones in Expressing Interpersonal Gratitude: An analysis from naturalistic behavioral observations	28
Roberts	Methodology to Assess Immune Cell Control of Endothelial Cell Fate Following Vascular Injury	29
Sisson	Effects of dietary energy and emulsifier on the performance and energy storage of pullets and young laying hens	30
Speaks	Assessment of Red Spruce Encroachment into Areas of Hemlock Decline at Mountain Lake	31
Szenas	Validating Behavioral Tasks for Measuring Aggression and Prosociality Using Self-Report Measures	32
Wales	Two-Year-Olds' Socioemotional Competence Predicts Expressive Vocabulary	33
Yu	A NOVEL APPROACH TO MARTIAN OBSTACLE DETECTION THROUGH ULTRASONIC TRANSDUCERS	34
Agarwal	A Triggered Search for a Fast Radio Burst Below 100 Mhz from SGR 1935+2154, using the Long Wavelength Array	35

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

Primary Presenter Last Name	Presentation Title	Poster Number
Ali	Optimizing the production of 3D printing filament using recycled plastics in low-resource settings through moisture content reduction	1
Aronson	Exploring the thermal biology of Culex pipiens assemblage mosquitoes	2

Roh	Efficient Large Language Models for Modernizing Early Modern English Texts	26
Sarmiento	Direct macrophage-smooth muscle cell interactions in the injured arterial wall	27
Schurtz	Resilience at the Local Level: Mapping Spatial Disparities in Food System Planning in Central Appalachia	28
Simson	Wheat-ness the Change: Sowing the Seeds of Regeneration	29
Stockli	Maternal facilitation of attention at age 2 predicts inhibitory control at age 3	30
Sullivan-Fielding	Assessing the seed-dispersal networks of common invasive fleshy-fruiting plants in Virginia	31
Trubenbach	The Implementation of Passive Sampling for Aquifer Microbial Risk Assessment	32
Vangaru	To pack or not to pack: Revisiting protein side-chain packing in the post-AlphaFold era	33
Weigel	Impacts of Tropical Storm Helene on Benthic Macroinvertebrate Assemblages in Central Appalachian Headwaters	34

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

Primary Presenter Last Name	Presentation Title	Poster Number
Anderson	The Cause and Frequency of a Middle Year Slump in Undergraduate Education at Virginia Tech	1
Bailey	Death Anxiety and Experiences of Familial Loss in Adolescence	2
Boudreau	The Cherry on Top: Using Experimental Debriefing as a Site of Linguistic Outreach	3
Cortes	Navigating the Nuance That is Me: A Mixed-Methods Approach to Understanding Antecedents and Outcomes of Workplace Code-switching	4
Dembele	Raman Spectroscopy: A Novel Approach for Schistosomiasis Detection in Low Resource Settings	5
Dutton	Stress and Participation in Outdoor Adventure Programming	6
Ealy	Microbial activity as a driving factor of organic compost effects on the growth of Plectosporium tabacinum	7
Edelson	Characterizing amino acid toxicity in Arabidopsis and the relief by Glutamine	8
Garrastegui Segarra	K63 Polyubiquitination as a Hippocampal Regulator of Appetite	9

Taylor	Correlation's Between the Passing of Erin's Law and Political Affiliations, Educational Funding Status, and Current Sexual Education Policies within each of the States in the U.S.	33
Thibodeau	Virginia Tech Football Games and Their Impact on Illicit Drug Presence in Local Surface Waters	34

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

Primary Presenter Last Name	Presentation Title	Poster Number
Barber	From Suspension to Solution: Engineering Insight Through Subcellular Localization	1
Barnes	Using Stratigraphy Changes to Infer Earthquake Rupture History on Sitkinak Island, Alaska	2
Brown	“The Same Old Playbook”: Exploratory Analysis of Social Media Commentary of Vice President Kamala Harris During the 2024 Presidential Election	3
Candelario	Evaluating the Accuracy of Owner-Reporting About Companion Dog Treat Consumption	4
Chinoy	Targeting the Catalytic Triad: Comparative Docking of Inhibitors and Agonists in JEV NS2B-NS3 Protease	5
Das	First Successful Collagen Induced Arthritis and Synovial Fluid Extraction in MRL/lpr Mice	6
Detloff	Identifying Potential Protein-Protein Interactions Along Bacterial Spore Inner Membrane	7
Dhaveji	Exploring the behavioral and neural impact of musical theater on individuals with neurodevelopmental disabilities	8
Do	Loss-of-Function of PERM1 in Skeletal and Cardiac Muscles of Systolic Heart Failure	9
Dominguez-Ruiz	Interpretation of Non-verbal Communication in Automotive Contexts	10
Dvali	The Effects of Urbanization and Brood Parasitism on Neuropeptide Y (NPY) Protein Abundance in Song Sparrow (Melospiza melodia) Nestlings	11
Gainer	Environmental Factors Influencing Resource-Guarding Dogs	12
Ganapuram	Optimizing Low-Intensity Focused Ultrasound (LIFU) Treatment Parameters: Comparative Analysis of Skull Density, Thickness, and Incident Angle in Humans and Canines	13
Gilles	Deciphering Phosphorylation-Induced Changes in α-Synuclein Structure using Drude Polarizable Simulations	14
Gregory	Antagonism of Inflammatory Signaling by NLRX1 During SARS-CoV-2 Infection	15

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

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Primary Presenter Last Name	Presentation Title	Poster Number
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Ayah Ali
Virginia Tech/Mechanical Engineering
Sambhavy Chapagain
Virginia Tech/Public Health
Shivani Tadikonda
Virginia Tech/Public Health
Victoria Tabacchi
Virginia Tech/Biology
Leah Van Gelder
Virginia Tech/Biomedical Engineering
Phoebe Plank
Virginia Tech/Biomedical Engineering

Optimizing the production of 3D printing filament using recycled plastics in low-resource settings through moisture content reduction

Access to global health innovation in low-resource settings can be advanced through the expansion of local manufacturing infrastructure to support preventative and reparative maintenance of medical devices. Resource constraints in accessing additive manufacturing tools can inhibit innovation capacity, but recycling readily-available plastics into 3D printing filament can sustainably support infrastructure development. This project leverages interdisciplinary collaboration to optimize an existent prototype by exploring methods of moisture reduction for enhanced filament recycling quality. Through a university-private sector collaboration between Virginia Tech students and Malawian hardware startup Micromek, the partners communicated regarding prototyping challenges and collaboratively diagnosed moisture content as a potential cause of filament quality issues. The teams strategized a prototyping process to effectuate successful system integration throughout the research progression. Subsequent research of various methods of drying enabled the group to establish a plan for prototyping and testing a drying sub-system. The investigation highlighted several feasible options for drying processes, including vacuum pumps, dehydrators, parabolic reflectors for heat-based drying, and charcoal or rice for absorption-based drying. The group then developed a testing plan to analyze the effectiveness of each drying method. Future research will continue the optimization of the prototype through testing each drying method and communicating findings, ultimately furthering the partnership to support global health innovation infrastructure in low-resource settings.

Mentor(s): Ashley Taylor, Biomedical Engineering and Mechanics, Virginia Tech
Andre Muelenaer, Biomedical Engineering and Mechanics, Virginia Tech
Penelope Muelenaer, Carilion School of Medicine, Virginia Tech

Fatema Almansoori
Virginia Tech/Biomedical Engineering
Anvitha Ponnada
Virginia Tech/Mechanical Engineering and Biological Sciences
Jess Onderchain
Virginia Tech/Computational Modeling and Data Analytics

Proposed use of 3D printing to treat proximal humerus fractures

Proximal humerus fractures are relatively common joint dislocations that are typically caused by blunt force trauma to the region, often in the form of vehicular accidents. Exploring additive manufacturing as a treatment option for proximal humerus fractures may positively impact patient health. Additionally, 3D-printed parts can be more customizable to each patient's needs and are more efficient to manufacture than some alternatives. With a special focus on the humeral head, this proposed work would apply a comprehensive experimental methodology to develop and evaluate prosthetic models for the proximal humerus. We will produce prostheses tailored to specific anatomical needs using modern 3D printing technologies. Designed to imitate possible effects found in real-world events, this proposed study hopes to assess the efficacy of the models by subjecting them to controlled blunt force damage inside a virtual environment. To enhance our models and enable precise assessment of the prosthetic performance under various stress conditions, we would compile an extensive dataset about proximal humerus fracture-dislocations. The 3D-printed joints should provide a better fit, guaranteeing a tailored alignment that improves comfort and functionality, reduces postoperative problems, and speeds recovery. Apart from variations in 3D printing techniques that could affect the homogeneity and caliber of the prosthesis, this proposed study has several restrictions, most notably a limited sample size that might limit the general applicability of the conclusions. Still, the specially designed prosthesis should improve the outcomes of treatment. Important problems with 3D-printed prosthesis biocompatibility and material strength call for careful integration with human tissue to guarantee endurance without compromising any other aspect. Reducing health hazards to people and maintaining methodological integrity depends on prioritizing ethical issues and protecting participant data.

Mentor(s): Amanda MacDonald, University Libraries, Virginia Tech

Omar Almasri
Virginia Tech/Biological Systems Engineer

Neurophysiological Evidence for The Role of Attention on Inhibitory Control During Childhood: A Preliminary Study

Inhibitory Control (IC) involves suppressing an autonomic behavior or response, making IC critical for cognitive, socio-emotional and academic development (Diamond, 2013). Studies demonstrate neurophysiological correlates of IC across development, with results indicating development of IC skills is linked to the maturation of prefrontal cortex (Friedman & Robbins, 2021). Current literature lacks consensus regarding the role that attentional skills play in the development of IC (Holmboe et al., 2018). We examined whether neurophysiological measures of attention correlate with IC in early to middle childhood.

Seventy children provided data at ages 6 and 9. IC was assessed using the number Stroop task; mean reaction time (RT) was the variable of interest, with lower RT related to better IC. At both ages, electroencephalogram (EEG) during baseline and during Stroop task at frontal scalp locations were examined. Consistent with previous research, we focused on theta frequency band (4-7 Hz) as our measure of attention.

At age 6, Stroop RT was not correlated with theta EEG during baseline or task (all r's $< .05$, all p's $> .47$). At age 9, Stroop RT was correlated with theta at left ($r = 0.164$, $p = 0.007$) and right ($r = 0.173$, $p = 0.004$) frontal scalp locations during baseline. There was no correlation between Stroop RT and frontal EEG during Stroop task. These data provide preliminary support for variation in brain activation patterns during IC tasks from early to middle childhood, suggesting attentional skills potentially play a role in IC development.

Mentor(s): Martha Ann Bell,Psychology, Virginia Tech
Vanessa Diaz Benitez, Psychology, Virginia Tech

Zoe Altizer
Virginia Tech/Biological Sciences

Ghost Stories: Examining the Flowering Times of Monotropa uniflora to Reveal Phenology Trends in Medicinal Plants

Many communities in rural southern Appalachia have become socially and economically secluded from the United States. This isolation has resulted in a severe lack of medical infrastructure in the region. To cope with this disparity, certain populaces resort to traditional uses of native plants with medicinal properties. However, the abundance of these plants may be negatively affected by increasing global climate change. To investigate the effect of increasing yearly temperature on medicinal plant populations, we studied the phenology of Monotropa uniflora, commonly known as ghost pipe. We downloaded data from the Global Biodiversity Information Facility (GBIF), which included both professionally curated and citizen science data. The phenology stage of 1000 plants from 1995 - 2025 was quantified using a standardized phenology scoring system. This system rated M. uniflora samples from 0 - 4 based on their observed flowering or fruiting stage. The {rnoaa}, {weatherr}, and {weatherData} packages were in R to acquire average monthly temperature data for each observation. A regression analysis was also performed to find the association between flowering date and temperature. Using this analysis, I predict a negative correlation between flowering date and temperature will be found. This is expected to result in earlier occurrence of each phenological stage. A drastic trend in earlier flowering dates could result in phenological mismatches between M. uniflora and the pollinators on which it relies. The resulting population declines could have notable impacts on Appalachian communities which rely on native medicinal plants like M. uniflora.

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

Sinclair Anderson

Virginia Tech/Environmental Science

Refining Regeneration & Transformation Techniques in Potato (Solanum tuberosum)

Potato (Solanum tuberosum) is the most important non-grain crop and fourth most produced crop worldwide. However, potato tuberization is inhibited by heat, and faces yield losses due to increased land surface temperatures. Genetic editing is a powerful tool to address these temperature-induced yield losses in potato. However, potatoes are generally recalcitrant to transformation and regeneration, making it necessary to develop a successful method in relevant cultivars before gene editing can be performed. Previous work in our lab refined methods for callus induction in in tissue culture, and we are now refining methods to induce shoot formation with the ultimate goal to regenerate a whole potato plant from tissue culture. For this purpose, we are using different plant hormones called cytokinins to induce shoot growth from callus and obtain regenerated plants. We formulated shoot induction media with various combinations of the two cytokinins, zeatin riboside and thidiazuron, to find the optimal procedure for shoot induction in potato. Some of our findings indicate that different compositions may be best suited for particular tissues.

Mentor(s): Courtney Leisner, School of Plant and Environmental Sciences, Virginia Tech

Sean Anderson
Virginia Tech/Statistics
Marcella Dodge
Virginia Tech/Psychology
Analiese Maciel
Virginia Tech/Cognitive and Behavioral Neuroscience
Addison Midkiff
Virginia Tech/Criminology

The Cause and Frequency of a Middle Year Slump in Undergraduate Education at Virginia Tech

Burnout during the undergraduate years of higher education is consistent throughout American institutions, with an average overall dropout rate of 25.7% (Hanson 2023). Virginia Tech holds an eight-year dropout rate of about 14% (College Factual 2024). However, anecdotal evidence from engineering students at VT shows a more internalized mental decline during sophomore and junior years, a 'Mid-Year Slump'. We define this subtle 'burnout' as a student's increased lack of interest, motivation, loss of faith in their education system, in themselves, and their future, increased emotional overwhelm, and feeling of social disconnection. Using these seven dimensions of burnout, we created an instrument to measure student burnout. The instrument includes a group of Likert scale questions for each of the dimensions of burnout. Our objective is to use validation techniques to ensure the reliability and accuracy of our instrument. These techniques include content and construct validity. In addition, with synthesizing a literature review on each of the seven dimensions to assess the validity of our instrument's contents. We are performing a factor analysis of our questions to assess the validity of the constructs (dimensions). Using our validated instrument, we can study the relationship between burnout and demographic factors or student behaviors. Peer studies show a correlation between financial status, relationship difficulties, health issues, and academic decline (Jevons 2019). By finding these relationships, we can identify strategies to help mitigate burnout for different demographics of students.

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

Timothy Anikis
Virginia Tech/Wildlife Conservation

Urban versus Rural Differences in Microplastic Abundance found in Caddisfly Larvae and Casings

Aquatic insect emergence varies seasonally and geographically and can range from hundreds to 150,000 individuals per square meter per year (Jackson and Fisher, 1986). As these insects emerge from freshwater systems, they can serve as a vector transferring pollutants to nearby terrestrial lands. This interaction highlights the transport of contaminants from aquatic systems to terrestrial, where emergent aquatic insects are essential food subsidies to bats, reptiles, amphibians, spiders, and birds at the riparian zone. Hydropsychidae (caddisflies) can be used to serves as bioindicators of pollution, similar to bivalves (Asian clams and mussels). Micro and nanoplastics are an emerging class of pollutant prevalent in all aquatic ecosystems. Recent research has demonstrated caddisflies to shred macroplastic litter for their nets and casings ultimately introducing microplastics into aquatic environments. Our research objective was to assess differences in microplastic abundance, morphology, and type from caddisflies in urban (Northern Virginia) and rural (Western North Carolina) areas. We anticipate finding a significant difference in microplastic abundance between the two study areas.

Mentor(s): Austin Gray, Biology, Virginia Tech

Helle Aronson
Virginia Tech/Biochemistry

Exploring the thermal biology of Culex pipiens assemblage mosquitoes

Climate change is causing shifts in the distribution of disease vector organisms including Culex pipiens Assemblage mosquitoes, posing human health risks due to their status as a West Nile virus vector in North America. Thus, a better understanding of their biology is needed for updating prediction models for their distribution and for the development of effective control mechanisms. For this project, Culex mosquitoes were collected along a latitude and temperature gradient in the United States to explore their thermal biology. Behavioral assays were conducted to determine these populations' thermal preference and thermal tolerance. We also studied the role of relative humidity and food type on these traits by feeding the mosquitoes two different types of food and by varying the level of humidity in the thermal gradient. In parallel, we ran another assay in which mosquitoes were gradually heated in an aluminum plate and their knockdown temperature was recorded. Our results showed the different populations, despite variations in food type, were driven to the same humidity, demonstrating that this factor seems to be more important than temperature in this assay. Our results also showed that food type, affecting nutrient stores, plays a role in their thermal preference, but not their temperature tolerance which remained constant across populations. This lays the groundwork for further instigation of the role of humidity and food quality on the thermal behavior of various mosquito species and the underlying evolutionary mechanisms driving these traits.

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

Amber Arthur
Virginia Tech/Animal and Poultry Sciences

Validating Half-Scale Feeding Systems Used in Dairy Calf Heifers

This study aims to validate a half-scale automated feeding system for dairy calf heifers. Being able to monitor milk intake and daily weights is extremely important in determining the effectiveness of a farm's nutritional management, while also helping monitor for sickness in calves. This study fits within the broader goal of improving animal husbandry and welfare by using technology to optimize feeding, minimize labor costs, ensure proper growth and health of calves, and provide a stable solution for the increasing demand of automated agriculture.

The goal of this research is determining if the system can provide consistent data on calf weights, how to correct inaccuracies moving forward, and how to enhance the reliability and efficiency of automated feeding and weight systems in the dairy industry.

The methods include recording the weights of calves once weekly and comparing this data to the automated feeding systems output, which involves monitoring the scale to determine factors that would affect such data, like feeding intervals, fluctuating temperatures, crowding, and sensor errors that can occur.

While the system is generally effective, certain inconsistencies in weight data have been noted primarily with the youngest, lightest calves, which prompts an investigation to determine the cause. By comparing weight data across a wide range of calves consistently, we expect to identify a specific cause by adjusting the system as errors arise to rule out potential variables, which may include calibration, cleaning, altering feeding, or changing how the data is processed. We expect that refining the system will increase overall reliability for most calves, but some challenges may remain for the extreme ends of the weight spectrum.

Mentor(s): Rebecca Cockrum, Dairy Sciences, Virginia Tech

Mohamed Awad
Virginia Tech/Mechanical Engineering

Prey-predator Mite Adaptability in Fibrous Environments

Two-spotted spider mites cause widespread havoc by destroying crops worldwide, feeding on the plant fluid from the foliage of over 1000 plant species. Spider mites achieve high efficacy in damaging crops by living on fibrous webs on the underside of leaves to shield themselves from predators and to lay eggs. The webs are composed of aligned and crossing fibers of diameters ranging from several hundred nanometers to microns. Predatory cucumeris mites are nature's answer to keep the prey spider mites in check. We sought to answer the fundamental question of how the size and architecture of the web provided the prey a mechanical advantage. To this end, we developed fiber-based strategies of suspended fibers of various diameters (200 nm to 8000 nm) in aligned and crossing patterns to quantify prey and predator locomotion (gaiting, speed, turning ability, etc.). We tracked single mites moving on fiber networks using high-speed microscopy (~1000 fps) and compared our findings against the traditional flat 2D glass control used in published studies. On flat 2D, both mites moved using tetrapod gait, which was partially maintained on large-diameter fibers and a network of two parallel fibers. With a decrease in fiber diameter, both mites moved with non-tetrapod gait, with the predators exhibiting a near-complete loss of movement at fibers approaching ~200 nm diameter. Thus, for the first time, our studies shed light on why spider mites might deposit ~200 nm diameter fibers in high numbers in their webs. Both mites could move using tetrapod gaiting on crosshatch dense patterns, which agrees with the literature. Overall, our results highlight the role of mechanical principles in guiding prey-predator interactions and provide new directions in designing pest management strategies.

Mentor(s): Amrinder Nain, Mechanical Engineering, Virginia Tech
Bahareh Behkam, Mechanical Engineering, Virginia Tech
Alejandro Del Pozo, Entomology, Virginia Tech

Kathleen Bailey
Virginia Tech/Clinical Neuroscience

Death Anxiety and Experiences of Familial Loss in Adolescence

This study investigates whether young adults who have experienced the loss of a close family member during adolescence exhibit heightened anxiety or fear of death in young adulthood. The goal is to examine the long-term psychological impact of adolescent bereavement and its implications for mental health. While prior studies have explored childhood grief, limited research has focused on how such experiences influence death anxiety later in life. To address this, we will conduct a quasi-experimental, survey-based study using convenience sampling. Participants will include young adults aged 18 to 25 who either have or have not experienced familial loss between the ages of 10 and 19. Data will be collected anonymously via an online survey including demographic questions, the Death Anxiety Questionnaire (DAQ), and items assessing connection to the individual lost and coping strategies. Ethical safeguards include informed consent, participant anonymity, and access to mental health resources. This study aims to contribute to the understanding of long-term grief effects and inform the development of targeted interventions to support bereaved adolescents into adulthood. We anticipate that individuals in the loss group will report significantly higher death anxiety scores than their non-loss counterparts. Moderating factors such as coping strategies are expected to influence outcomes. Independent t-tests and ANOVA will be used for data analysis, with statistical controls for confounding variables.

Mentor(s): Tae-ho Lee, Psychology, Virginia Tech
Sammy Hong, Virginia Tech
Ya-Yun Chen, Virginia Tech
Josh Neal, Virginia Tech

Nora Bajramaliu
Virginia Tech/Biochemistry
Eva Novikov
Virginia Tech/Biochemistry
Claire Wolz
Virginia Tech/Biochemistry
Maia Arnason
Virginia Tech/Biochemistry
Kayla Cahill
Virginia Tech/Biochemistry

Enhancing Acetylcholinesterase Inhibition: A Structural Modification of Huperzine A

Alzheimer's disease is a progressive neurodegenerative condition associated with a decline in memory and cognitive function. Research has shown that the brains of individuals with Alzheimer's have lower levels of acetylcholine compared to those without the disease. Acetylcholine is naturally broken down in the body by the enzyme acetylcholinesterase (AChE), leading to the development of several drugs, such as donepezil and huperzine A, to inhibit this enzyme. However, huperzine A has limited affinity for AChE, which reduces its effectiveness in preventing the breakdown of acetylcholine. The goal of this experiment was to develop a ligand with greater interaction strength at the AChE active site to improve therapeutic outcomes. A modified ligand was designed with the addition of a carbon ring and the substitution of two nitrogen atoms with oxygen atoms to increase electronegativity and enhance interactions with the target site. Computational analysis showed that the new ligand had a more favorable predicted binding energy, improving from 10.0 kcal/mol to 11.3 kcal/mol, reflecting a 13% increase in interaction strength. These results suggest the modified ligand could more effectively inhibit AChE and help maintain acetylcholine levels. A drug therapy using this new ligand may be more potent for managing the symptoms of Alzheimer's disease.

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

Hiya Barai
Virginia Tech/Biological Sciences

Size of aquatic macroinvertebrates as an indicator of stress in response to environments with heavy mining activity

Mountaintop removal coal mining has increased the specific conductance of streams in central Appalachia up to 1200 uS cm causing a decline in certain local aquatic macroinvertebrate taxa. The composition of species in these environments has been shifting from numerous salt-sensitive mayflies and flies to more salt-tolerant species, leading to biodiversity loss. We predict that salt-intolerant species remain, but are stressed as a response to increasing ion concentrations. These taxa might reallocate energy resources to focus on survival rather than growth. This study aims to identify if the size class and the wet-to-dry weight ratio of remaining populations of 3 salt-sensitive taxa indicate stress across a salinization gradient in a sample collected from 9 streams in August 2024. The chosen taxa include 2 scraper groups (Stenonema and Optioservus) and 1 shredder group (Leuctra) to see how salt sensitivity differs in macroinvertebrates with different food sources. We predicted that the taxon-specific sizes and wet-to-dry mass ratios will decline across this gradient in the 3 taxa identified based on their life history traits (e.g. feeding mode, respiration, and potential to disperse). Findings from this study will identify indicators of stress prior to local extirpation. This information can also be used to monitor how mining could reduce population-level fitness and the capacity for performing expected stream ecosystem functions.

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

Chris Barber

Virginia Tech/Biomedical Engineering

From Suspension to Solution: Engineering Insight Through Subcellular Localization

Industrial hemp (Cannabis sativa with <0.3% Δ^9-THC), legalized seven years ago in 2018, resulted in rapid expansion of producing hemp as a crop. The crop produces many cannabinoids that can be very valuable, but the biosynthetic production of these cannabinoids is not currently easy to control. Understanding these pathways, and being able to manipulate them will result in improved crop value, as the value is dependent on its cannabinoid profile. However, producing transgenic hemp plants is difficult, while transgenic callus suspension cultures are far easier to produce, at the fault of not producing very much cannabinoids. The goal of the project is to discover the subcellular localization of cannabinoid biosynthetic genes in Cannabis cell suspensions. This is achievable by investigating gene expression and localization in this system, using confocal microscopy of fluorescently tagged biosynthetic proteins. This should uncover key factors that limit cannabinoid production in cell suspensions, allowing for more informed metabolic engineering.

Mentor(s): Bastiaan Bargmann, School of Plant and Environmental Sciences, Virginia Tech

Adele Barnes
Virginia Tech/Geosciences

Using Stratigraphy Changes to Infer Earthquake Rupture History on Sitkinak Island, Alaska

The Alaska-Aleutian subduction zone is a seismically active region that frequently generates great (Mw>8.0) earthquakes. The geologic record is vital in understanding the long-term rupture behavior of the subduction zone—it catalogues thousands to millions of years of geologic events, making it a valuable resource for future projections and seismic hazard models. Land-level changes caused by subduction zone earthquakes are recorded in coastal stratigraphy, as changes in the depositional environment lead to changes in sediment type. We use these sudden shifts to investigate when past earthquakes occurred and their severity. Sitkinak Island is located on the Alaska-Aleutian subduction zone and is the primary region of study. It has been proposed that there is a non-persistent rupture boundary—where some earthquakes stop at Sitkinak while others rupture through. This research seeks to understand whether this megathrust always ruptures in the same way, or if these discrepancies are simply due to landscape changes. To do so, stratigraphic and grain size analyses were conducted on a 130 cm sediment core collected from the island. Using a Malvern Mastersizer 3000, samples taken in ~1 cm increments were analyzed in order to create a grain size profile of the core. The results indicate that changes in lithology are largely consistent with past research. We identified two intervals in the core that suddenly coarsen to sand, which may indicate tsunami deposition. Further research in this area will contribute to the paleoseismic record in Alaska, clarifying rupture patterns on the Alaska-Aleutian subduction zone.

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

Abby Bartz
Virginia Tech/Cognitive and Behavioral Neuroscience
Camila Villena
Virginia Tech/Cognitive and Behavioral Neuroscience
Jessica Liang

Virginia Tech/Clinical Neuroscience

Emily Moreau

Virginia Tech/Biochemistry

Allie Barksdale

Virginia Tech/Cognitive and Behavioral Neuroscience

Ashley Vitulli

Virginia Tech/Clinical Neuroscience

Anushka Jain

Virginia Tech/Biology

Evaluating the Impact of Choral Group Singing on Emotions of Choir Members Including Individuals with Dementia and Their Caregivers

This study explores the association between health outcomes of choir singing for persons living with dementia, their caregivers, college students, and adult community members. As dementia rates rise, there is a growing need for non-pharmacological interventions that promote emotional well-being and reduce stress. We aim to expand research on the potential of music and social interaction to alleviate negative symptoms associated with dementia. Further, this study fosters intergenerational connection, which may help reduce stigma surrounding aging. In its second year, this research builds on previous findings to further examine the emotional and physiological outcomes of choir participation. We hypothesize that all participants will experience improved mood and increased heart rate variability (HRV) following each session, indicating reduced stress. We also anticipate that results will align with the positive outcomes observed last year. Participants, ranging in age from 3 to 96, were recruited through VT news, community flyers, and word of mouth. Weekly rehearsals are held on Thursday evenings at Virginia Tech's Creativity and Innovation District building. Each session begins with 30 minutes of socialization and snacks, during which consented participants complete pre-rehearsal mood questionnaires. During the hour-long rehearsal, participants wear smartwatches to monitor HRV while singing popular music, dancing, and playing handheld percussion instruments. Post-rehearsal mood questionnaires are completed afterwards. We expect participation in this intergenerational choir will enhance positive emotions and increase HRV. These findings have the potential to further support music-based, community-centered interventions for well-being of all participants.

Mentor(s): Joanna Culligan, Human Development and Family Science, Virginia Tech
Violet Zaleski, Human Development and Family Science, Virginia Tech

Hannah Beasey
Virginia Tech/Biological Sciences

The Impact of Interstitial Fluid Flow on CAR T cell Motility

Glioblastoma (GBM) is the most common and malignant form of primary brain tumors in adults. Currently, immune stimulating treatments like chimeric antigen receptor (CAR) T cells are being investigated as a potential treatment for GBM. CAR T cell therapy faces challenges created by the solid tumor mass, including higher interstitial fluid flow (IFF) from the tumor and hostile tumor microenvironment (TME). Our project is focused on the impact of TME and IFF on CAR T cell motility and tumor cell killing within the brain. We did this through live imaging of the CAR T cells in vitro as well as in vivo studies within mouse brains. Our results show that CAR T cell motility is impacted by the surrounding cells, including glioblastoma tumor cells and the tumor microenvironment, as well as fluid flow.

Mentor(s): Jennifer Munson, FBRI, Virginia Tech

Lise Bejtlich
Virginia Tech/Mathematics
John Kohler
Virginia Tech/Mathematics
Yiqiu Cao
Virginia Tech/CMDA

Monsky's Theorem and Tropical Geometry

In this project, we explore Monsky's Theorem, a striking result in geometry which states that it is impossible to divide a square into an odd number of equal-area triangles. The original proof of Monsky's Theorem uses 2-adic valuations and we present a novel and visual approach by interpreting the problem through the lens of tropical geometry. We begin with the concept of a Sperner coloring, a combinatorial labeling of triangle vertices using three colors, which under certain constraints guarantees the existence of at least one triangle with all three colors — a "rainbow triangle." Using this, we show that any triangulation of the square with Sperner boundary conditions must contain such a triangle. To connect this to Monsky's result, we turn to tropical geometry. By using the tropical polynomial $p(x,y)=x\oplus y\oplus 1$, we divide the plane into three regions that naturally induce a Sperner coloring on the vertices of a triangulation. We verify that the Sperner conditions are satisfied for this coloring and then use properties of the tropical semiring to understand the implications for triangle areas.
Finally, we extend the 2-adic valuation from the integers to the reals via a field extension and show that under this valuation, any rainbow triangle in the coloring cannot have rational area 1/n for odd n, completing the proof of Monsky's Theorem through tropical methods.

Mentor(s): Leo Herr, Mathematics, Virginia Tech

Sean Binning
Virginia Tech/Clinical Neuroscience
Matthew Robbins
Virginia Tech/Clinical Neuroscience

Rachel Grayek
Virginia Tech/Cognitive and Behavioral Neuroscience
Molly Pangretic
Virginia Tech/Cognitive and Behavioral Neuroscience
Lauren Schalik
Virginia Tech/Clinical Neuroscience

Rewiring Recovery: Neuroscience Education for Empowered Healing in Substance Use Disorder Treatment

The Neuroscience of Drug Addiction course we're currently enrolled in integrates service learning into its curriculum. Understanding the neurological basis of substance use disorders (SUD) is essential for empowering individuals in recovery and supporting informed decision-making. Our project aims to develop and deliver a neuroscience-informed curriculum for adults undergoing outpatient treatment for opioid, alcohol, stimulant, and other SUDs through the Office-Based Addiction Treatment (OBAT) program at Community Health Center of The New River Valley. The purpose of this work is to bridge the gap between scientific understanding and accessible education by providing accurate, engaging, and non-stigmatizing content about the brain, addiction, and recovery. To create this curriculum, we shortlisted topics and sought feedback on our list from the community mentors. Our group then conducted a literature review of foundational neuroscience topics and addiction-specific research. Topics include neuroanatomy, neurotransmission, the brain's reward circuitry, neuroplasticity, predispositions to addiction, and the impact of trauma and comorbidities. We also explore pharmacokinetics, pharmacodynamics, and medically assisted treatments (MAT), emphasizing how treatment drugs differ from substances of misuse. Our expected outcome is a three-part educational series that will be presented directly to participants in the OBAT program, with opportunities for discussion and feedback. We anticipate that participants will gain a clearer understanding of how addiction affects the brain and body, as well as insight into the science of recovery. Ultimately, this project contributes to community-engaged scholarship by fostering mutual learning and empowering recovery through neuroscience education.

Mentor(s): Aparna Shah, School of Neuroscience, Virginia Tech
Rachel Alderman, Peer Recovery and Community Health Worker Supervisor, Community Health Center of The New River Valley
Petrie Whitney, Director of Recovery Programs
Lily Smith, TA, School of Neuroscience, Virginia Tech

Morgan Bishop

Virginia Tech/Biological Sciences

Dog Aging Project Grain Free Diet Validation

The Dog Aging Project (DAP) is an ongoing study following more than 50,000 companion dogs by collecting data on health, lifestyle, and environmental factors that contribute to dog longevity. Data from a comprehensive diet survey created by the DAP was collected from owners annually. This survey asked owners specific questions about their dog's diet including if the diet contained grains or was grain free and if it was home prepared or commercially made, and if so, the dog food and type of food. The goal of this study was to validate the accuracy and consistency of owners' reports on their dog's diet by comparing data collected from the same owners in two different years, 2021 and 2023. Current findings suggest a relatively high level of accuracy in owners' reports with consistency throughout. We anticipate this level to remain consistent with further analysis. The level of uncertainty found from this study can contribute to later studies that focus on comparing grain free diets to dog health conditions such as cardiovascular health, skin health, and well-being.

Mentor(s): Audrey Ruple, BMVS, Virginia Tech
Janice O'Brien, BMVS, VMCVM, Virginia Tech

Madison Blake
Virginia Tech/Animal and Poultry Science

The Impact of Colostrum Lactose Supplementation on Neonatal Holstein Calf Passive Immunity and Health Scores

Of the factors that influence the growth of dairy cattle, immunity acquisition within the first few days of life is one of the most important. Newborn dairy calves acquire passive immunity through the ingestion of antibody-rich colostrum sourced either from cows or colostrum replacer. The subsequent levels of the antibody IgG gained from the ingested colostrum, measured from a blood sample taken 48-72 hours after the first meal, describes the acquisition of passive immunity. Sufficient passive immunity acquisition is indicated by IgG values greater than or equal to 10g/L. After colostrum ingestion, passive immunity rises and falls, leading to a period of high risk for calves before they gain active immunity. The objective of this project was to examine the effects of colostrum replacer with or without supplemental lactose on passive immunity acquisition and on observed calf health scores from birth to 70 days of age. To this end, neonate Holstein heifers (n = 30) were assigned to one of two observational groups and were given colostrum replacer without and with supplemental lactose (Groups A and B respectively). Of the 13 calves within Group A and the 17 calves within group B, 5 calves belonging to Group A (35%) and 3 calves belonging to Group B (18%) achieved sufficient passive immunity. Health scores including cough score, nasal discharge score, fecal score, eye score, ear score, and rectal temperature (°F) were measured daily for 70 days. Overall, for fecal score, eye score, ear score, and nasal discharge ($p<0.01$), Group B was observed to have higher health scores between the two groups, indicating more adverse health conditions compared to observational Group A. The results also showed higher health scores (indicating adverse health condition) corresponding to the expected timeline for low levels of calf immunity for both Groups A and B. Further research is needed to better observe the effect of additional lactose in immunity acquisition in Holstein calves.

Mentor(s): Rebecca Cockrum, Department of Dairy Science, Virginia Tech

Tara Blue
Virginia Tech/Ecological Restoration

Better Late than Never: Comparing Spring and Summer Varieties in a Changing Climate

Appalachia is a folk medicine hotspot home to many plants with culinary and medicinal uses, but climate change could cause range shifts that impact access to native plants. Loss of these species would negatively impact foragers. I will create Ecological Niche Models showing possible habitat ranges of significant Appalachian plant species by combining reported species occurrence data with a set of predictions for future greenhouse gas emissions.

I classified a group of Appalachian plant species into spring and summer flowering varieties using the Flora of Virginia, then used the Global Biodiversity Information Facility website to compile species occurrence data from iNaturalist, museums, and herbaria. My R script constructs Ecological Niche Models using the dismo package by combining climate conditions with reported species occurrences to calculate the probability of species occupancy in specific areas. I modeled the habitat range shifts resulting from various carbon emission scenarios predicted in the Representative Concentration Pathways (RCPs), then mapped species occurrence probability using QGIS to illustrate shifts in habitat ranges across the eastern United States.

By comparing species distribution under various RCPs, I can visualize shifts in potential Appalachian plant habitats caused by climate change. Range shifts may hinder forager access to native plant species and cause a decrease in edible plant and folk medicine traditions.

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

Sarah Boudreau
Virginia Tech/Psychology
Caroline McCormick
Virginia Tech/English Literature

The Cherry on Top: Using Experimental Debriefing as a Site of Linguistic Outreach

Debriefings are typically used to explain study goals to participants, but we explore how they can also be a site of outreach for linguists. We investigated participant responses to debriefings conducted after a study based on Kang and Rubin (2009), which we ran online using Prolific (N=176), and in-person in non-linguistic college classrooms (N=121). Our online and in-person debriefings revealed deception, inspired curiosity with the McGurk effect, and educated participants about reverse linguistic stereotyping. In-person we additionally connected results to students' personal experiences of teacher evaluation. In written responses from in-class participants, the debriefing was commonly described as informative and interesting. Prolific participants responded to the debriefing on a 7-point scale, rating informativeness ($\bar{x}$=6.41) and impact of the debriefing on positivity about the study ($\bar{x}$=6.11). These results suggest that debriefings can be leveraged as an opportunity to foster positive perceptions of linguistics and communicate with the public.

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

Allison Bower
Virginia Tech/Agricultural Technology
Emily Sears
Virginia Tech/Agricultural Technology

Stockpiling Tall Fescue

Effect of nitrogen fertilizer rate on stockpiled tall fescue yield, total digestible nutrients, and crude protein. To reduce the cost of stored feed, producers rely on stockpiled tall fescue. The purpose of the study is to determine if there is a response in four different fertilizer rates in yield, total digestible nutrients, and crude protein. Two different sites were used to collect the samples monthly from November to April. A 4X4 block was used where each rate was repeated four times. Analysis pending, and we are hoping to find a positive yield, total digestible nutrients, and crude protein response.

Mentor(s): Wesley Gwaltney, Agricultural Technology, Virginia Tech

Logan Braun

Virginia Tech/Ecological Engineering

Engineers in Action Summer 2024 Bridge Build

This project, a collaboration with Engineers in Action and students from both Virginia Tech and Duke University, aimed to complete a service and cultural exchange through the construction of a pedestrian bridge spanning the Castilla Mayu River in Toracari, Bolivia. This river, due to seasonal flooding, is only passible 150 days out of the year. The goal of this footbridge, in a more isolated community, was to ensure year-round access to education, healthcare, and employment. This specific bridge construction would connect the smaller surrounding communities to the Toracari community, which is the most heavily populated within the region and, as a result, possesses many resources including health centers, a primary and secondary school, and transportation links to larger urban centers. The project preparation included months of bridge design, material planning, travel logistics, and the development of a construction and cultural engagement strategy. On-site, the team worked closely with local residents and masons to build the bridge while also engaging in daily community activities such as soccer games and cultural events, emphasizing the importance of mutual respect and relationship-building. The bridge build was completed on June 26th, spanning 89.3 meters. It now provides safe, consistent access across the Castilla Mayu River for approximately 605 individuals, including 20 school-aged children. My travel participation was supported by the 2024-25 Jacklyn W. and William R. Jones, Jr. Experiential Learning Scholarship.

Mentor(s): Matthew James, Dept. of Engineering Education, Virginia Tech

Olivia Brick
Virginia Tech/Dairy Science

Mapping Antarctica's Hidden Cryosphere: Predicting Ice Loss Through Subglacial Dynamics and Accelerated Ice Sheet Thinning in a Changing Climate

This study investigates how subglacial lake activity and ice sheet dynamics contribute to accelerated Antarctic ice loss, sea-level rise, and climate system disruption. It addresses the following questions: How do subglacial melt processes accelerate ice discharge, contribute to ice sheet thinning, and destabilize glaciers? How does the absence of sea ice and iceberg presence in certain regions indicate faster melting trends and shifting ice loss patterns? What are the broader implications of Antarctic meltwater for ocean salinity, thermohaline circulation, climate feedback loops, and wildlife habitats?
The project bridges gaps in understanding how the cryosphere responds to warming, with an emphasis on hidden subglacial processes and ice sheet thinning. A mixed-methods approach combines satellite-derived literature of subglacial hydrology with field observations from a study abroad technical report, including glacier retreat data and iceberg censuses. Citizen science tools—such as repeat photography, geographic mapping, and climate modeling—support the analysis of ice loss patterns.
Findings suggest glaciers are losing stability earlier in the melt cycle, with less ice surviving long enough to form icebergs. This indicates that subglacial drainage and warmer ocean currents are accelerating ice loss. In addition to physical changes, the resulting habitat loss threatens Antarctic wildlife, including krill, penguins, and seals that rely on stable sea ice and ocean conditions. The findings will refine climate projections and support global conservation efforts. Anticipated outcomes include a climate vulnerability map identifying regions at risk of irreversible ice sheet collapse and a call for urgent climate mitigation to address progressive environmental impact.

Mentor(s): Lynn Resler, Department of Geography, Virginia Tech

Kedean Brown
Virginia Tech/Psychology

"The Same Old Playbook": Exploratory Analysis of Social Media Commentary of Vice President Kamala Harris During the 2024 Presidential Election

In 2024, Vice President Kamala Harris made history as the first woman of color nominated by a major political party for a U.S. presidential election. However, the underrepresentation of Black women in leadership roles raises concerns about the impact of racial and gender stereotypes, particularly in the political and leadership spaces. This study seeks to understand how stereotypes targeting Black women, such as the Mammy, Angry Black Woman (ABW), Strong Black Woman (SBW), and Jezebel (Melson-Silimon & Thomas, 2025), are utilized in social media, particularly in YouTube commentaries on Harris's campaign, and their potential implications for the perception of Black women leaders. This study seeks to answer the question, "To what extent do social media outlets such as Youtube include stereotypic speech associated with Black women when describing Kamala Harris?" We conducted an exploratory content analysis of 239 YouTube videos featuring commentary on Harris's campaign. Coders used a 5-point Behaviorally Anchored Rating Scale to rate the presence of each stereotype in each video. Results indicated that the SBW stereotype and the ABW stereotypes were most prevalent in the video commentary, portraying Harris as resilient and emotionally tough. While such attributes may be seen as strengths, they may also contribute to the "glass cliff" phenomenon, in which Black women are placed in high-risk leadership positions with little support (Cook & Glass, 2013). These findings highlight the importance of evaluating Black women leaders beyond limiting stereotypes. A follow-up study will investigate how exposure to stereotypic speech influences public perceptions of Harris's leadership ability.

Mentor(s): Arturia Melson-Silimon, Department of Psychology, Virginia Tech
Marla L. White, Pamplin College of Business, Virginia Tech
Ivan Hernandez, Department of Psychology, Virginia Tech
Rebecca Harmata, Department of Psychology, University of Georgia

Caroline Brown

Virginia Tech/Molecular and Cellular Biology

Quality of life of Leiomyosarcoma survivors: Continued screening for recurrence

This project aims to study the impact of cancer diagnosis, treatment, survival, and continued screening for recurrence on the quality of life of leiomyosarcoma survivors. This project will be conducted virtually with no direct contact with participants. Eligible participants will then receive access to the study questions. The survey is a one-time virtual survey. First, we will collect demographic information to characterize the sample, including age, race or ethnicity, and gender. We will then collect more specific details to help us characterize the sample, including information on past leiomyosarcoma recurrences, travel to screenings for recurrence, and interactions with medical providers. Many of these questions are open-ended with boxes to allow participants to share details about their experiences. Next, we include the GAD-7 (General Anxiety Disorder) and PHQ-8 (Patient Health Questionnaire) instruments to assess symptoms of anxiety and depression. Finally, we invite participants to share any additional thoughts in open-ended questions.

Mentor(s): Joseph Gallo, Public Health, Virginia Tech

Chanera Brown

Virginia Tech/Biochemistry

Caleb Kline

Virginia Tech/Biochemistry
Ethan Sumner
Virginia Tech/Medicinal Chemistry
Daniel Bui
Virginia Tech/Biochemistry

Computational Investigation of Binding Pocket Residues in JAR1 Jasmonic Acid-Amino Synthetase

Plants retain few defense mechanisms, although understanding and replicating these mechanisms is crucial for the optimization of crop resilience and adaptability. Of the few defenses plants do possess, stress responses represent a large majority, and can induce chemical, morphological and physiological changes to help protect plants from the environment. In particular, leaf breakage and changes in temperature trigger the jasmonate signaling pathway, which utilizes the Jasmonic Acid-Amino Synthetase 1 protein (JAR1). In the present study, molecular modeling software is utilized to mutate the TRP336 residue to three other hydrophobic amino acids (AA), including larger (TYR336) and smaller (ALA336 and VAL336) residues. Mutations were performed and docked with the original ligand, Jasmonyl-l-isoleucine (JA-lle), to compare its affinity in relation to the original JAR1 protein. The original re-docking of TRP336 in its crystal pose had an affinity of -7.8 kcal/mol, and resultant affinities of other mutated AA are discussed herein. Most notably, TRP336 and TYR336 had the highest single and average pose affinity. The ligand JAR1 docked more favorably with these AA than would have occurred naturally. While the exact reasons are speculated upon in this study, electronic contributions from the aromatic rings or the large steric hindrance from the size are suspected. The low binding efficacies of VAL336 and ALA336 could be explained with the same aforementioned reasons. These findings highlights JAR1’s specificity and functional importance in jasmonate signaling and suggests further research to investigate other residue mutations and to better understand the structural contributions of TRP336.

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

Laura Bruno
Virginia Tech/Wildlife Conservation

Carnivore Trap Rates and Naive Occupancy over 2012-2022 at Mountain Lake Biological Station, Giles County, Virginia

Carnivores influence ecosystems through top-down control; however, their elusive, wide-ranging behavior makes them challenging to study. To overcome this, I utilized data collected from camera traps set up and monitored by the Virginia Tech student chapter of The Wildlife Society at Mountain Lake Biological Station (MLBS), in Giles County. Analyzing the period from 2012-2022, I monitored activity and distribution of mammalian carnivore species. Focal species include gray fox (Urocyon cinereoargenteus), red fox (Vulpes vulpes), eastern coyote (Canis latrans), bobcat (Lynx rufus), and eastern black bear (Ursus americanus). I used average trap rate (events per total trap nights) as a metric of activity, and naive occupancy (number of stations captured out of total stations) as a metric of distribution.
Gray fox had the lowest trap rates of all focal species (GFTR = 0.056) and black bear had the highest (BBTR = 6.262). Coyote (CTR = 4.067) demonstrated a significant increase in trap rates. Gray fox, red fox (RFTR = 0.063), and black bear showed no significant difference in trap rates. Bobcat (BTR = 1.720) showed significant difference between select years. Naïve occupancy results showed black bear with highest occupancy (88.5%) and red fox with lowest (2.6%). Gray fox (3.6%) was next lowest, followed by bobcat (49.7%) and coyote (54.97%). Results of this study demonstrate the need for further research in Virginia to assess the activity and distribution of mammalian carnivore species across varied habitats. Future work will include conducting occupancy analysis including covariates thought to influence carnivore occupancy and detection.

Mentor(s): Marcella Kelly, Department of Fish and Wildlife Conservation, Virginia Tech
Victoria Monette, PhD, Department of Fish and Wildlife Conservation, Virginia Tech

Christina Bujoreanu
Virginia Tech/Smart and Sustainable Cities
Madelyn Morrow
Virginia Tech/Biology
Grace Martinez
Virginia Tech/Public Health
Elizabeth Pepaj
Virginia Tech/Public Health

TEAM-Malawi: Addressing Food Insecurity in Africa with Hydroponics

Controlled environment agriculture enables growers and farmers to produce yields outside typical growing seasons. Especially in Sub-Saharan Africa, a region with wet and dry seasons, the ability to utilize controlled environment agriculture systems, such as hydroponics, to produce crops year-round gives these systems the potential ot address food insecurity and malnutrition in ways traditional agriculture cannot. In resource-limited nations like Malawi, a lack of online access to technical information has slowed and challenged the hydroponics industry. To address these challenges, our team has collaborated with colleagues at The MakerzSpace, a nonprofit organization based in Blantyre, Malawi, to design and evaluate hydroponics systems and t4echniques that permit the growth of staple crops (including, but not limited to, tomatoes, kale, spinach, and pumpkin) outside the typical growing season. The 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 developing an organic liquid fertilizer from locally available food waste. Ultimately, our team aims to partner with our collaborators in Malawi as they implement the final designs in schools and hospitals.

Mentor(s): Martha Sullivan, Industrial Design, Virginia Tech
Andy Muelenaer, Biomedical Engineering, Virginia Tech

Sean Burke
Virginia Tech/Biochemistry
Ayla Warren
Virginia Tech/Biochemistry
Kelsie Chang
Virginia Tech/Biochemistry
Connor Layton
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Bethany Teti
Virginia Tech/Biochemistry

Computational Mutation of β-Lactamase Reveals Reduced Ceftriaxone Binding at Ser42

Antibiotic resistance is a global crisis that has persisted despite the continued development of antibiotic medications. Among the most widely used classes of antibiotics are β-lactams, which include penicillin derivatives commonly used to prevent or treat bacterial infections. A protein produced by Mycobacterium tuberculosis, β-lactamase, binds to and hydrolyzes β-lactam antibiotics, rendering them ineffective. This underscores the importance of identifying key residues involved in β-lactamase activity to prevent hydrolysis of the β-lactam ring. A computational approach was used through molecular visualization to mutate Serine-42, a key catalytic residue in β-lactamase, to Lysine. The ceftriaxone ligand was then docked into the mutated β-lactamase protein to assess changes in predicted binding free energy. A binding affinity of −7.3 kcal/mol was observed for the mutated protein, which is less favorable than the wild-type protein's binding affinity of −8.9 kcal/mol. These results suggest that the Ser42Lys mutation reduces ceftriaxone binding, potentially impairing β-lactamase's ability to deactivate the antibiotic. The observed change in ligand binding affinity indicates that targeted mutagenesis of catalytic residues may represent a viable strategy in designing inhibitors or modifying β-lactamase function as part of efforts to combat antibiotic resistance.

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

Maria Canan
Virginia Tech/Food Science and Technology

Characterizing the Effects of Microorganisms on Beer Quality and the Brewing Process

Beer is a complex fermented beverage, and its quality is heavily influenced by various microbial organisms present throughout the brewing process. During the fermentation of beer, specific yeast strains are typically added to achieve a desired flavor profile in the fermented product. Certain bacterial strains are commonly added as well to introduce specific sensory attributes to the flavor, mouthfeel, and aroma. When uncontrolled, however, these bacteria can produce undesirable flavors, reduce shelf life, and lead to financial losses for the brewers. This study aimed to characterize the effects of various spoilage bacteria and yeast on beer by analyzing changes in pH, specific gravity, and dissolved oxygen. To achieve this, wort samples were first inoculated separately with Brettanomyces bruxellensis or Saccharomyces cerevisiae to initiate fermentation and allowed to ferment for two days. After this initial period, each 100 mL batch of fermented beer was inoculated with 3.5 mL of bacteria, including Lactobacillus brevis, Gluconobacter oxydan, and Pediococcus damnosus. Unfermented wort was used as the negative control. Chemical properties were measured using pH, specific gravity and dissolved oxygen tests. Results showed a decrease in pH across all samples, with the most significant drop observed in the B. bruxellensis sample. Specific gravity initially increased and then decreased during fermentation with all S. cerevisiae samples reaching a specific gravity of 1.005, while the B. bruxellensis sample was slightly higher at 1.035. Dissolved oxygen readings were variable but demonstrated a significant drop in oxygen presence after seven days of fermentation. This study provides insight into microbial influences on beer quality, creating a deeper understanding of contamination risks and potential applications for controlled fermentation in brewing innovation.

Mentor(s): Rachel Cheng, Food Science and Technology, Virginia Tech
Diego Fredes-Garcia, Food Science and Technology, Virginia Tech
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Allison Candelario
Virginia Tech/Biochemistry

Evaluating the Accuracy of Owner-Reporting About Companion Dog Treat Consumption

This project examined how accurately dog owners report how often they give their pet dog treats. Understanding this can help improve pet health by identifying gaps between what owners believe they feed and what they actually feed. We recruited dog owners enrolled in the Dog Aging Project (DAP), a long-term, longitudinal study of companion dogs, to complete a diary about what they feed their dogs for three days. We then compared their diary answers to survey information they had provided as part of the DAP study to see how well the survey results matched reality. Our early findings show that many owners overreport or underreport treat frequency. This suggests that self-reported data related to treat feeding may not always be reliable, which has implications for researchers as well as veterinarians when giving pet healthcare advice.

Mentor(s): Audrey Ruple, The Dog Aging Project, Vet-Med, Virginia Tech
Janice O'brien, Dog Aging Project, Vet-Med,Virginia Tech

Catherine Caputo
Virginia Tech/Construction Engineering and Management

Assessment of Traditional and Robotic Approaches to Interior Construction Layout: A Framework and Comparative Study

As the construction industry witnesses a growing integration of robots and automated systems on complex construction sites, project teams exhibit varying definitions of successful robot employment. Notably, there is an absence of standard criteria for stakeholders to assess the impacts of these technologies on productivity, cost, safety, and pertinent human factors. Existing studies suggested key framework elements, yet none provided a comprehensive, quantitative means to assess on-site construction robots. In response, this study introduces a holistic framework of Key Performance Indicators (KPIs) as a reference for researchers to evaluate single-task robots. A case study was conducted using a set of extracted KPIs, comparing the traditional construction interior layout method with the performance of a single-task, mobile layout robot. The study demonstrates a comparative approach that project teams can adopt to maximize robot benefits and meet project-specific goals.

The case study accounts for the unpredictability of robot implementation that project teams may need to adapt to. The results highlight drawbacks of recent automation, such as technological inefficiencies. Depending on the application, these challenges can increase project completion time and affect space utilization. This research presents a comprehensive productivity analysis of a recently introduced mobile layout robot. Additionally, we highlighted robot advancements in comparison to previous layout robots assessed in past studies. Of which provide positive implications for cost and safety. The conclusions offer insight into the feasibility of adopting these technologies and considerations for stakeholders seeking to implement them.

Mentor(s): Ashtarout Ammar, CEM, Virginia Tech
Ashley Johnson, CEM, Virginia Tech

Alexandra Caraus
Virginia Tech/Biochemistry
Morgan Griffith
Virginia Tech/Biochemistry
Ava Comstock
Virginia Tech/Biochemistry
Aashma KC
Virginia Tech/Biochemistry

The Effect of Point Mutation Ser70Cys on Ceftriaxone Binding to β-Lactamase of Mycobacterium tuberculosis

Mycobacterium tuberculosis is the leading cause of death from a single infectious agent, displaying resistance to β-lactam antibiotics through chromosomal mutations that produce β-lactamase enzymes. β-lactamases hydrolyze β-lactam antibiotics, thereby exhibiting antibiotic resistance by preventing bacterial cell wall disruption. This study investigates the effect of the point mutation Ser-70 to Cys-70 on the binding affinity of Ceftriaxone, a primary β-lactam antibiotic, to M. tuberculosis' β-lactamase. β-lactamase was analyzed using molecular visualization techniques, where residue Ser-70 was mutated to Cys-70 via computational mutagenesis. Ligand and receptor files were separated, with the wild-type receptor serving as the control and the mutated receptor as the experimental condition. Molecular docking simulations were performed, applying optimal box parameters established from control conditions to the mutated receptor. Contrary to the hypothesis that mutation Ser70Cys would reduce Ceftriaxone binding affinity due to active site conformational changes, results revealed a significant increase in binding affinity, improving from -3.1 in Ser-70 to –7.8 in Cys-70. More negative binding affinity values indicate stronger intermolecular interactions, suggesting Cys-70 enhances receptor-ligand binding. Structural analyses suggest that the Ser70 Cys mutation may alter hydrogen bonding interactions, unexpectedly stabilizing ligand binding and reducing the distance between β-lactamase and Ceftriaxone, resulting in a tighter binding pocket. These findings suggest that specific point mutations may reinforce rather than weaken antibiotic binding, highlighting nuances in protein-ligand interactions that challenge conventional structure-function expectations.

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

Nina Cava
Virginia Tech/Environmental Science

The Impacts of the Relationship Between Endocrine-Disrupting Compounds and Microplastics on Freshwater Crayfish Reproductive Health

Microplastics (MPs) are an emerging contaminant of global concern. They share a complex relationship with endocrine-disrupting compounds (EDCs), that are able to mimic estrogen in the bodies of many organisms. Previous research has focused on the effects of either MPs or EDCs on marine fish and terrestrial organisms but is unable to explain how the relationship between MPs and EDCs affect freshwater crayfish, an often-overlooked keystone species in many freshwater systems. I aimed to find what effects the leaching of EDCs from MPs has on the reproductive cycle of the adult female crayfish, Cambarus appalachiensis. I simulated how the MP polystyrene (PS) acts as a vector to adsorb and leach bisphenol-A (BPA), an EDC commonly used in plastic manufacturing, and compared it to effects of crayfish dosed with BPA alone. I observed growth rate and the concentration of the egg-development lipoprotein, vitellogenin (Vtg). Vtg concentration is a biomarker for estrogen exposure and BPA mimics estrogen in animal bodies. I hypothesized a decrease in Vtg levels in the crayfish dosed with BPA and BPA-treated PS, because the BPA should leach into the water column and mimic estrogen in crayfish bodies, causing them to produce less Vtg. The treatment may have biological effects that also slow the growth rate of the crayfish. Microplastics and endocrine-disruptors pose a widely known threat to many species, but gaining insight on the specific mechanisms gives insight on how to reduce harm and improve the health of freshwater ecosystems around the world.

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

Bao Chau
Virginia Tech/Civil Engineering

Concrete 3D Printing: A Solution for Affordable Housing

3D concrete printing (3DCP) is rapidly growing due to its wide range of advantages over conventional cast concrete. However, one major concern is that it 3DCP mixes typically have high cement contents and have a high carbon footprint as a result. Quarry by-products (QB) are a significant waste material available in the US, with estimated productions close to about 175 Mt/yr. Using QB as a partial replacement to cement would not only reduce the carbon footprint but also show a viable usage for the otherwise waste material. In this study, QB pond fines resulting from washing crushed stone was used as a partial replacement of cement and QB screenings resulting from gradation limits was used as a full replacement of the fine aggregate. Pond fines have a dual purpose in this study: replacing cement partially and also as a rheology modifier to aid with shape retention and thixotropy of 3D printable concrete. The suitability of this concrete for the purpose of 3D concrete printing is determined based on the strength (compression and tension), material characterization (calorimetry and XRD), rheology (viscosity, yield stress, and thixotropy) and print properties (extrudability, shape retention, and buildability). Prototyping of products is conducted using a Tvasta SIRA RC-20 mobile robotic arm 3D concrete printer.

Mentor(s): Alex Brand, Civil & Environmental Engineering, Virginia Tech
Kamakshi Tippabhotla, Civil & Environmental Engineering, Virginia Tech

Khushi Chaudhari
Virginia Tech/International Relations

Southern Vowel Shift in Southwest Virginia

One hallmark of Southern American English is the Southern Vowel Shift (SVS), which includes the fronting and raising of the vowel /ɪ/ (so that "bit" may sound closer to "beat"), the raising and fronting of /ɛ/ (making “bed” sound more like “bid”), and the lowering and diphthongization of /e/ (making "bay" sound more like "be-ay"). However, Dodsworth and Kohn (2012) have found reversal of this shift in urban North Carolina: speakers are starting to sound less stereotypically Southern. In this project, I investigate whether SVS is active in Southwest Virginia (SWVA) – a rural, Appalachian part of the broader Southern dialect region - and if so, whether gender plays a role in its expression. Using a corpus of recorded interview speech from 16 SWVA speakers aged over 50, I examine four SVS vowels (/ɪ/, /i/, /ɛ/, /e/) across male and female participants, by acoustically analyzing the first two formants of each vowel. Preliminary results show that most speakers have features of the SVS, but it depends on their gender and education.

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

Julia Cheng
Virginia Tech/Biological Science.

John Porter
Virginia Tech/Environmental Science

Kathryn Ouimet
Virginia Tech/Biological Sciences.

Allison Montgomery
Virginia Tech/Ecological Restoration

Tim Anikis
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Sam C. Purvis
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Tessa Thibodeau
Virginia Tech/Biological Sciences

Ted H. Docev
Virginia Tech/Geosciences

Madeline C. Keene
Virginia Tech/Wildlife Conservation

Matthew May
Virginia Tech

Campus Cocktails: A Case Study Evaluating Microplastic and PFAS Co-occurrence in Drinking Water on a College Campus

Microplastics and per- and polyfluoroalkyl substances (PFAS) are found in almost every environment and are known to be globally distributed, especially in aquatic systems that serve as drinking water sources. This presents a challenge to drinking water managers since these contaminants are of concern to human health. While recent regulations set limits on some PFAS in drinking water, only 6 of the over 14,000 compounds were addressed. Aside from California law, microplastics are not currently regulated in drinking water. Recent calls for research, such as a proposed bill in Virginia to study microplastics in drinking water, highlight concern over our lack of data on microplastic occurrence in drinking water, a pathway of exposure to contaminants for humans. Both microplastics and PFAS are recognized as public health hazards but are largely studied separately. In most cases, college campuses present interesting case studies to assess this risk due to the number of people that utilize drinking water and varying ages and demographics. To assess the public health risk of these co-contaminants, our objective was to understand baseline levels of microplastics and PFAS in drinking water on a college campus. Microplastics (3-week sampling; 3 days a week) and PFAS (2-week sampling; 3 days a week) were sampled concurrently from high-use drinking water taps/fountains across Virginia Tech's campus to evaluate their presence and variation over time. Our findings serve as a case study, providing insight into the occurrence and exposure students, staff, and faculty face on a college campus to two of the most recognized pollutants globally.

Mentor(s): Austin Gray, Biology, Virginia Tech

Kaley Chinoy
Virginia Tech/Biochemistry

Targeting the Catalytic Triad: Comparative Docking of Inhibitors and Agonists in JEV NS2B-NS3 Protease

Japanese Encephalitis Virus (JEV) is a positive sense, single-stranded, orthoflavivirus that has approximately 68,000 reported human cases per year, with around 20,000 cases being fatal. JEV can lead to severe swelling of the Central Nervous System (CNS) that often results in either death or long-term neurological complications such as memory loss, frequent seizures, or paralysis. This study investigates how the potential inhibitor 3-methoxy-deacetylketoconazole (M) interacts with the NS2B-NS3 main protease of JEV, in comparison to the known agonists ketoconazole (K) and deacetylketoconazole (D). Proteolytic processing of this polyprotein by the NS2B-NS3 serine protease complex is required to release individual nonstructural proteins, enabling assembly of the viral replication complex. This study aims to elucidate the differential binding mechanisms of inhibitors and agonists to the NS2B-NS3 protease in order to better understand their effects on enzymatic function. Three small molecules—3-methoxy-deacetylketoconazole (M), ketoconazole (K), and deacetylketoconazole (D)—were docked into the JEV NS2B-NS3 structure (PDB ID: 4R8T), and the resulting poses were analyzed through molecular visualization and binding free energy estimation to identify the most energetically favorable conformations. Interaction fingerprint analysis revealed that the inhibitor (M) forms multiple contacts with the catalytic triad residues of 4R8T (His51, Asp75, Ser135), whereas the agonist (K) shows no interactions with these sites. These findings suggest that M may inhibit NS2B-NS3 function by directly blocking the active site, thereby preventing polyprotein access. This insight highlights a potential mechanism of action for orthoflavivirus inhibitors and supports their relevance in therapeutic development against orthoflaviviral diseases.

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

Emma Cleveland
Virginia Tech/Systems Biology
Sarah Fuccello
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 with the formation of senile plaques composed of Amyloid-β42 (Aβ42) aggregates. Aβ42, the principal toxic species associated with AD, induces cytotoxicity through oligomerization and interaction with neuronal membranes, resulting in destabilization and ion leakage. Free lipids, such as 1-palmitoyl-2-oleoyl-sn-glycero-3-phosphocholine (POPC), are abundant in extracellular environments proximal to the membrane surface and are theorized to facilitate the membrane penetration of Aβ42. It is thought that Aβ42-lipid interactions modulate mechanisms of Aβ42 cytotoxicity. However, the co-aggregation of Aβ42 and free lipids is poorly understood. Molecular dynamics (MD) simulations were conducted to investigate Aβ42-POPC interactions and study the aggregation and structural morphologies of hexameric, octameric, and decameric Aβ42 in conjunction with free POPC. Clustering and radius of gyration analyses reveal distinct size-dependent modulation of Aβ42 interactions by free lipids. While POPC reduced inter-protein contacts in hexameric systems, it enhanced them in decameric systems, leading to increased aggregation propensity. Notably, the fatty acid chains of POPC are preferentially buried compared to the hydrophobic amyloid residues, increasing the solvent-exposed hydrophobic surface area (SASA) of Aβ42, which could promote further oligomerization through increased nucleation events. In membrane simulations, free lipids exhibited minimal membrane interaction, whereas Aβ42's aliphatic linker regions displayed the strongest membrane association. Future work and analysis will aim to identify the key factors that enable Aβ42 membrane interactions, specifically how lipids modulate oligomer interactions with the membrane, offering further mechanistic insights into neurodegenerative pathology.

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

Cecilia Cortes
Virginia Tech/Psychology
Ariana Hill
Virginia Tech/Psychology

Navigating the Nuance That is Me: A Mixed-Methods Approach to Understanding Antecedents and Outcomes of Workplace Code-switching

Empirical evidence suggests that employees belonging to racial minority groups are more likely to be rated as more professional when they engage in code-switching, defined as how minority groups alter their hair, dress, language, and other behaviors to navigate different social environments (McCluney et al., 2021). However, this research is limited in scope, as it does not address the effects of code switching within minority individuals' own communities. Additionally, existing research overlooks recent studies indicating that evaluation gains made by code-switching may come at the cost of detrimental psychological and job-related outcomes. Thus, we must explore these nuanced experiences of underrepresented individuals and expand theoretical definitions of code-switching to include both intracultural (within the same culture) and intercultural (within different cultures) contexts. Therefore, we will adopt a mixed-methods framework across two studies. The first study explores which qualitative themes emerge to define various strategies and antecedents of code-switching among people of color within the United States. Expanding upon initial interviews, the second proposed study aims to quantitatively replicate expected relationships between expected antecedents and motivations of code-switching with both intracultural and intercultural code-switching. Preliminary findings link contextual cues—within individual's work and home—to decisions to engage in code-switching behavior. Additionally, participants cite different motivating factors for intercultural (e.g., lack of organizational diversity) versus intracultural (e.g., avoiding judgement from ingroup) code-switching. A complete analysis of research findings will be conducted prior to the presentation. We will also discuss theoretical and practical implications for organizations, such as organizational culture and climate.

Mentor(s): Arturia Melson-Silimon, Psychology, Virginia Tech

Noa Croitoru
Virginia Tech/Psychology
Ella Reitmeier
Virginia Tech/Psychology

Identifying Early Maladaptive Schemas that Associate with Alcohol Use and Problems among Adults in Residential Treatment for Opioid Use Disorder

Alcohol use contributes to opioid overdose deaths and has been linked to poorer outcomes in opioid maintenance therapy. As such, it is critical to mitigate alcohol use among individuals with opioid use disorder (OUD). An extension of cognitive behavioral therapy, Schema Therapy, gained support in recent years as a treatment for adults with substance use disorders, including OUD. Schema Therapy targets early maladaptive schemas (EMS; i.e., longstanding patterns or traits that often develop in response to trauma and impact thoughts, emotions, and behavior in problematic ways) to reduce unhelpful coping mechanisms such as substance use. Although investigators have linked specific EMS to OUD and alcohol use disorder separately, schemas that contribute to alcohol misuse among adults with OUD remain unidentified, thereby hindering tailored intervention approaches for this high-risk population. To inform tailored interventions for individuals with OUD who misuse alcohol, this study identified EMS that associate with greater alcohol use/problems among adults in residential treatment for OUD. Based on prior EMS research, we hypothesized that Insufficient Self-Control and Pessimism EMS would positively associate with alcohol use/problems. This chart review identified early maladaptive schemas that associate with alcohol use among adults in residential treatment for Opioid Use Disorder (N=107). Approval seeking, insufficient self-control, and social isolation schemas positively, and subjugation negatively, associated with alcohol use among adults with OUD, indicating Schema Therapy should target these domains within this population.

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

Morgan Crum
Virginia Tech/Wildlife Conservation

Weller's Wannabe? Investigating Possible Mimicry between Desmognathus orestes and Plethodon welleri

Batesian mimicry occurs when a model species displays warning coloration to signal an unfavorable trait to predators, and a mimic species possesses the same coloration, but no such trait. This phenomenon has been observed in salamander species such as Plethodon jordani, the model, and Desmognathus imitator, the mimic. In this case, P. jordani produces a noxious, unpalatable secretion that is sticky and acts as a deterrent to predators while D. imitator does not. A mimetic relationship has been hypothesized between two species found in the Mount Rogers National Recreation Area: Plethodon welleri (model with noxious secretions) and Desmognathus orestes (mimic with no secretion). In this study, we surveyed sites separated by 30.5 m in elevation, in Virginia’s Smyth, Grayson, and Washington counties. Bidirectional transects of 10 m by 5 m were completed at each site. For each P. welleri and D. orestes, we matched their color to a swatch in the Herpeton Color Catalogue for Field Biologists. We then calculated the proportions of overlapping colors for D. orestes and P. welleri for each elevation. To further evaluate dorsal color similarity, we extracted RGB values from photos of each salamander using ImageJ photo analysis software. We then compared the similarity between P. welleri and D. orestes color values at each elevation using a Color Overlapping Index (COI). Our results suggest that D. orestes appears to be mimicking P. welleri based on the similarity of dorsal colors in areas of co-occurrence and a significantly reduced similarity in areas without co-occurrences.

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

Mary Crumpacker
Virginia Tech/Computer Science

Computer Systems Genome Project: Data and Endpoints Management

The Computer Systems Genome Project: Codebase and Data Management

Authors: Katelyn Crumpacker
Advisors: Margaret Ellis, Godmar Back, Kirk Cameron

The purpose of the Computer Systems Genome project is to gather data about computer systems, hardware, and hidden figures in computing into one database accessed through our website which uses an open source Client API. The project then takes this data and analyzes it in a variety of visualizations in order to catalog the lineage of computer systems and hardware overtime as well as the connections between different hidden figures in computing.

One challenge with this project is managing large amounts of data. In order to increase the retrieval speed of this data, caching was implemented using flask caching and Redis memory cache. This reduces the load on the server when there is a high volume of API requests. This caching technique provides a lot of abstraction; however, careful attention was paid in making sure data in the cache was removed if there were any changes made to the database via internal developers or external crowdsourcing. Benchmarking showed that caching was able to improve the data access speeds on the CSGenome website.

Another challenge has been managing the codebase, particularly logging, which is crucial for tracking the system's operations. Our application runs using Gunicorn and Flask and this configuration has caused the disappearances of log statements. As a result, there has been investigation of logging configurations with Gunicorn and Flask to set up logging for the CSGenome code base.

Mentor(s): Margaret Ellis, Computer Science, Virginia Tech
Godmar Back, Computer Science, Virginia Tech
Kirk Cameron, Computer Science, Virginia Tech

Charlotte Cunningham
Virginia Tech/Psychology
Maya Williams
Virginia Tech/Psychology
Addison Swenson
Virginia Tech/Psychology

Increasing the Use of Reusable Grocery Bags with an Innovative Intervention

"Without large-scale behavior change, the annual flow of plastic into the ocean will triple over the next 20 years, limiting climate regulation and severely harming ecology. Most grocery store customers choose single-use plastic bags over reusable bags. This behavioral science research has been evaluating the impact of an innovative intervention implemented to increase the use of reusable bags at two Kroger grocery stores near campus. Trained undergraduate student researchers are recording certain demographics of individuals leaving a Kroger store with their groceries in plastic bags, and respectfully offering them an attractive tag to hang in their vehicle as a reminder to bring returnable bags for their groceries next time. Preliminary results indicate that of these customers (n=85), 59% were female and 44% were male. In addition, 49% were between 0-30 years of age, 29% were between 1-60 years old, and 22% were 61+ years old. The customer's reactions to the reminder tags were as follows: a) 47% displayed a positive reaction to the reminder tag by gladly accepting the car tag with a smile and a "thank you

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

Rebecca Cuthbertson
Virginia Tech/Psychology

From Infancy to Toddlerhood: How Maternal Sensitivity and Inhibitory Control Shape Anxiety Outcomes

The responsiveness and sensitivity of parents (e.g., emotionally supportive, positive attitude; DeWolff & van IJzendoorn, 1997) supports infant-maternal attachment and is significant in understanding the development of anxiety in childhood. Specifically, higher levels of positive maternal behavior are associated with lower levels of later child anxiety. We investigated early maternal sensitivity (i.e., responding contingently to the child's behavior), while focusing on the child's temperament trait of inhibitory control (IC). IC is characterized by the ability to inhibit or override a dominant response and instead use more appropriate or subdominant responses and behaviors (Rothbart et al., 2003). We hypothesized that increased early maternal sensitivity would predict lower anxiety problems later and examined whether temperamental IC moderated the association between early sensitivity and later anxiety problems.

There were 192 participants from a community sample. Maternal sensitivity was behaviorally coded at 10-months during a mother-child interaction task. IC was maternally reported at 24-months using the Early Childhood Behavior Questionnaire. Anxiety problem scores were maternally reported at 36-months using the Child Behavior Checklist.

We performed a multiple regression analysis. There was a significant interaction between child IC and maternal sensitivity ($b = 1.196$, $SE = 0.395$, $p = 0.002$). Maternal sensitivity at 10-months negatively predicted anxiety at 36-months only for children with low and moderate levels of IC. There was no relationship at higher levels of IC at 24-months. This indicates that maternal sensitivity may be a protective factor for children with lower IC, being minimally impactful for children with stronger self-regulation skills.

Mentor(s): Martha Ann Bell, Department of Psychology, Virginia Tech
Isabela de la Rosa, Department of Psychology, Virginia Tech

Samanvitha Dammalapati
Virginia Tech/Clinical Neuroscience

Challenges Adolescents with Autism Spectrum Disorder Address in Therapy

Autism Spectrum Disorder (ASD) is characterized by differences with social communication and restricted/repetitive behaviors and interests. Autistic adolescents frequently have challenges involving social interactions, internalized mental health struggles, executive functioning, and emotion regulation. Accordingly, psychotherapy is recommended to develop behavioral and coping skills. Research exploring the concerns of autistic youth regarding psychotherapy, however, is limited. This analysis aims to investigate the types of problems autistic adolescents report addressing in therapeutic settings. As part of a larger mixed methods project, 10 30-minute interviews with autistic adolescents (age range: 13-17; mean age: 14.8; gender identity: 20% female, 70% male, 10% other) were conducted, coded, and analyzed to elucidate qualitative themes and frequency of challenges they reported discussing in therapy. Findings indicated the following challenge types, from most to least common—Internalizing problems (referenced by 7/10 individuals, 39% of all codes), Peer Socialization (6/10 individuals, 19% of codes), Sources of Stress (6/10 individuals, 13% of codes), Family Conflict (4/10 individuals, 13% of codes), Trauma (3/10 individuals, 10% of codes), and Externalizing Problems (2/10 individuals, 6% of codes). Identifying these difficulties can help clinicians and researchers identify evidence-based practices and therapeutic modalities best suited to address client-specific needs.

Mentor(s): Angela Scarpa, Psychology Department, Virginia Tech
Elizabeth DeLucia, Psychology Department, Virginia Tech

Crystal Dang
Virginia Tech/Microbiology

Exploring the host range of flagellotropic phages: Chi and Chi related phages

Bacteriophages (phages) are viruses that exclusively infect bacteria. Phage therapy is emerging as a promising alternative to antibiotics, particularly in combating bacterial infections of multidrug resistant (MDR) pathogens. A significant advantage of phage therapy in clinical treatment is the specificity of phages targeting individual bacterial species while maintaining the host microbiome. Flagellotropic phages, which specifically require rotating host flagella for infection, offer a unique advantage in phage therapy. If target bacteria become non motile to avoid infection, they will experience an evolutionary trade off as motility is a major virulence factor. The most well-studied of the flagellotropic phages is Chi (χ), which has been proposed as a worthy candidate for phage cocktails. In this study, we used plaque assays to test the host range of Chi and two Chi-related phages (iEPS5 and YSD1) against different, clinically relevant serotypes of Salmonella enterica. So far, we have tested 27 isolates and identified differences in their host range. In the future, we plan to continue testing these and other Chi-related phages to identify the best candidates for a Salmonella phage cocktail. Future research will include phage training using the Applemans protocol to develop evolved phages with broader host ranges through bacterial coinfection.

Mentor(s): Birgit Scharf, Biological Sciences, Virginia Tech

Arpita Das
Virginia Tech/Clinical Neuroscience

First Successful Collagen Induced Arthritis and Synovial Fluid Extraction in MRL/lpr Mice

In lupus patients, 65% to 95% experience arthritis at some point during the course of their disease. MRL/lpr mice are autoimmune mice that show systemic autoimmunity, massive lymphadenopathy, arthritis, and glomerulonephritis. To further study lupus-associated arthritis, we performed a collagen-induced arthritis (CIA) in lupus mice, MRL/lpr female mice. Over a period of 42 days of clinical observation, with two injections of collagen type II (CII) emulsified in complete Freund's adjuvant (CFA) on days 0 and 22, we observed swelling moderately in mouse paws after the first injection of CII+CFA in treated mice. After the second injection, we observed severe arthritis in treated mice, we also observed arthritis in control MRL/lpr because they develop systemic autoimmunity, including arthritis. Because MRL/lpr mice have little to moderate arthritis, the treatment of CII+CFA exacerbated lupus-associated arthritis. After euthanasia, we extracted more synovial fluid from CIA mice knees with a very innovative technique using a Melgisorb compared to control non-treated mice. This experiment further provides a potential model for lupus-associated arthritis as well as a technique for murine synovial fluid extraction.

Mentor(s): Rana Estaleen, Department of Pathobiology and Immuniology, Virginia Tech

Michael Davidson
Virginia Tech/Cognitive & Behavioral Neuroscience

Katherine Clarke

Virginia Tech/Cognitive & Behavioral Neuroscience

Isha Kolhatkar

Virginia Tech/Clinical Neuroscience

Ella Hayward

Virginia Tech/Clinical Neuroscience

Neuroscience in Action: Bridging Policy, Community, and Harm Reduction through Service Learning

In our Neuroscience of Drug Addiction course, our group project integrates academic learning with hands-on service through active participation in Students for Sensible Drug Policy (SSDP). The primary goal of our project is to connect neuroscience education with harm reduction, community empowerment, and evidence-based drug policy reform. By engaging directly with populations affected by substance use and with those shaping policy, we aim to humanize addiction and promote a science-informed approach to change.

Our work focuses on three core activities: distributing harm reduction supplies at local "Electrolyte Night" events (including naloxone, fentanyl test strips, electrolytes, and educational materials), engaging with local and regional leaders during a community panel titled "The Neuroscience of Addiction: Where Science Meets Policy", and contributing to ongoing SSDP initiatives that emphasize education, advocacy, and destigmatization.

The purpose of this work is to extend neuroscience beyond the classroom and apply it to the real world—demonstrating how understanding brain function can inform compassionate, data-driven public health strategies. Through this project, we aim to reduce stigma, foster productive dialogue, and advocate for policies that reflect current scientific understanding of addiction.

Outcomes include strengthened relationships with community partners, increased public awareness around harm reduction resources, and personal development in areas like civic engagement, public health advocacy, and science communication. Our work illustrates how neuroscience students can be meaningful agents of change, leveraging their knowledge to support marginalized populations and shape a more humane approach to drug policy.

Mentor(s): Aparna Shah, School of Neuroscience, Virginia Tech
Meredith Lane, School of Liberal Arts, Virginia Tech
Connor Will, School of Liberal Arts, Virginia Tech
Samantha Styles, College of Science, Virginia Tech

Morgan Davis
Virginia Tech/Microbiology
Nathan Gillispie
Virginia Tech/Geography
Lauren Urbanic
Virginia Tech/Neuroscience
Sophia Ragucci
Virginia Tech/Psychology

Comparison and Discussion of USA Vaccination Rates of Pre and Post COVID-19

The COVID-19 pandemic led to increased efforts in disease-prevention messaging in order to prevent the spread of the virus. Previous research has shown that this messaging may have coincided with vaccination rates for other diseases, such as influenza. This study investigated how influenza vaccination rates changed over time across the United States of America. Using data from AmericasHealthRankings, the Kaiser Family Foundation, and the CDC for U.S. citizens 18 and older, we analyzed the influenza vaccination rates for the 50 states from 2016 to 2023. Influenza vaccination rates peaked on average in 2020, coinciding with the beginning of the COVID-19 pandemic, but have slowly declined since. 44 out of the 50 states saw an increase in influenza vaccination rates in the years following 2020. More research is needed to determine the factors influencing the changes in influenza vaccination rates over time.

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

Sydney Deane
Virginia Tech/General Studies

The Impact of Alternative Marketing Strategies on the Perception of Shelter Animals.

This research explores the effectiveness of short video marketing in increasing animal adoptions at shelters, comparing it to traditional photo-based methods. Overcrowding remains a persistent issue in U.S. animal shelters, making it essential to identify strategies that improve adoption rates. While previous studies highlight the impact of presentation on adoption decisions, limited research addresses the role of video content. This study examines whether short videos better engage potential adopters, especially younger generations who are more accustomed to video-based interactions. By focusing on biases related to breed and appearance, this research also investigates whether video clips offer a more dynamic and accurate portrayal of adoptable animals, potentially reducing such biases. Preliminary findings indicate that video marketing captures an animal's personality more effectively than static images, fostering stronger emotional connections and appealing more to prospective adopters. This study contributes to the understanding of how modern digital marketing strategies can improve adoption outcomes, offering shelters practical tools to address overcrowding and enhance the visibility of animals in need of homes.

Mentor(s): Katherine Davis, Blacksburg High School

Caroline DeDecker
Virginia Tech/Psychology
Helina Abraham
Virginia Tech/Psychology
Kilee Pearson
Virginia Tech/Psychology

Differential Perceptions of Misogyny in Digital Presentations: Impact of Gender, Religion, and Political Affiliation

The normalization of social media consumption has led to impressionable audiences becoming more casually exposed to misogyny. Additionally, the prevalence of misogynistic content online has caused hatred, prejudice, and discrimination against women both online and in real-world situations, emerging as a pressing societal concern. This study applied TikTok videos to investigate discrepancies in perceptions of misogyny online as a function of gender, and other sociocultural dynamics. Specifically, this research investigated the impact of the following human dynamics on an individual's perception of misogyny: a) religious affiliation, b) level of devotion to an organized religion, c) political affiliation, and d) level of agreement with the 2024 presidential candidates. A total of 170 participants reported demographic information and rated 20 TikTok videos on a 5-point Likert Scale that assessed the participant's perception of misogyny and humor in the content. The results revealed that people who are members of an organized religion display significantly lower perceptions of misogyny. Additionally, significantly lower perceptions of misogyny and higher perceptions of misogyny-related humor were observed from the following groups of participants: a) people assigned male at birth, b) people who are devoted to an organized religion, c) conservatives, and d) Trump supporters. Significant gender-based discrimination was observed from online presentations and suggest a need for interventions targeting particular sociocultural contributors to online presentations of misogyny.

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

Jilliane Dela Vega
Virginia Tech/Biochemistry
Noah Brown
Virginia Tech/Biochemistry
Songlin Liu
Virginia Tech/Biological Sciences
Ethan Phan
Virginia Tech/Biochemistry

Targeted Mutation of HIS-17 in Adenosine Deaminase Enhances Predicted Ligand Binding

Adenosine Deaminase (ADA) is an enzyme that regulates high levels of adenosine and 2’-deoxyadenosine by converting them into inosine and 2’-deoxyinosine, respectively. Dysregulation of adenosine or 2’-deoxyadenosine causes premature lymphocyte cell death, which reduces immune system function and can lead to conditions such as sudden infant death syndrome (SIDS) and ADA deficiency. This study investigated the role of ADA and how its functionality may be modulated through alterations in its protein-ligand interactions. Several mutations were introduced using molecular visualization. HIS-17 was selected for mutation due to its close interaction distance with the ligand 9-deazainosine. HIS-17 was mutated into glutamic acid, tryptophan, and glycine to assess the effects of differing side chain properties on ligand binding. Molecular docking was used to calculate the binding affinities between the ligand and the mutated proteins. Results showed more favorable predicted binding energies for all three mutations (H17E, H17W, H17G) compared to the wild-type crystal structure. Analysis of protein-ligand interactions revealed that H17E formed the strongest hydrogen bond interactions. However, the observed bond lengths and interaction patterns indicated only minor structural improvements relative to the wild type. These results suggest that altering HIS-17 may enhance ligand binding affinity with 9-deazainosine, although overall structural impact remains limited. Examining the molecular interactions of ADA may inform new strategies to improve its functionality and mitigate associated immune-related disorders.

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

Jilliane Dela Vega
Virginia Tech/Biochemistry
Kirsten Perrin
Virginia Tech/Microbiology
Fauuzia Asfa
Virginia Tech/Neuroscience
Taylor Chappell
Virginia Tech/Neuroscience

Mutating Corticotropin-Releasing Hormone Receptor 2 (CRHR2) Using Molecular Visualization

Around 1 of every 5 adults deal with stress related disorders in their lives. Corticotropin-releasing hormone receptor 2 (CRHR2) causes an increase in stress when interacting with the Hypothalamic-Pituitary-Adrenal (HPA) axis of the brain. This axis communicates between the hypothalamus, the pituitary gland, and the adrenal gland which manage stress levels in the body. We looked to mutate CRHR2 in a way that decreases the binding affinity. In this project, we mutated the binding site of the receptor, GLC2, with the intention of decreasing the binding affinity. PyMOL 3.1 molecular visualization software was used to generate an image of CRHR2 from the Protein Data Bank (PDB). Using the mutagenesis wizard feature in PyMOL, GLC2 was removed from the protein receptor to show the new interaction. We expect that altering the structure of the GLC2 receptor in CRHR2 will decrease or inhibit the binding of CRHR2 in the HPA axis. By decreasing or inhibiting binding of CRHR2, the overall effects of stress disorders would be lowered. Researchers could utilize these findings in new medications using drug targeting in vivo to decrease the binding levels of CRHR2.

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

Louhan Dembele
Virginia Tech/Public Health

Agatha Madej
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Sam Brown
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Virginia Tech/Public Health

Shubo Zhang
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Amber Russell
Virginia Tech/Biological Sciences

Daniel Sane
Virginia Tech/Biochemistry

Raman Spectroscopy: A Novel Approach for Schistosomiasis Detection in Low Resource Settings

The parasite Schistosoma haematobium causes schistosomiasis, which can develop into bladder cancer in humans if it is not detected and treated early on. Schistosomiasis has a high prevalence in Malawi, a low-income country in southeastern Africa. Early intervention is possible should there be accurate and cost-efficient screening. Currently, district hospitals in Malawi are utilizing microscopic detection of schistosomiasis by qualified technicians, taking 45 to 60 minutes for processing. Raman spectroscopy (RS) is a novel technology that detects biomarkers of 2 mL urine samples in less than 15 minutes. RS creates a "molecular fingerprint" by outputting a wavelength spectrum that corresponds to different biomarkers, which allows for the pinpointing of abnormalities. RS theory and methodology were presented to various medical, scientific, and engineering groups in Malawi. Our aim is to streamline the detection process through appropriate affordable technology, which can be integrated with current disease management programs, building point-of-care screening and diagnostic capacity.

Mentor(s): Andy Muelenaer, Biomedical Engineering and Mechanics, Virginia Tech
John Roberston, Biomedical Engineering and Mechanics
Yuba Gautam, Public Health, Virginia Tech
Penny Muelenaer, Pediatrics and Infectious Diseases at VT Carilion, Virginia Tech

Rishab Desai
Virginia Tech/Computational Modeling and Data Analytics
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Virginia Tech/CS Engineering
Trisheka Panikker
Virginia Tech/CS Engineering
Chaitanya Davuluri
Virginia Tech/CS Engineering
Ryan Grant
Virginia Tech/Computational Modeling and Data analytics

Enhancing Instructor Feedback: Sentiment-Based Summarization of Student SPOT Surveys at Virginia Tech Using NLP

This project utilizes Natural Language Processing (NLP) and data science techniques to speed-up and enhance the analysis of student feedback collected through SPOT (Student Perception of Teaching) surveys. Our goal is to assist professors—particularly those teaching large-enrollment courses—in efficiently interpreting student responses to improve their teaching methods and class design. Using Python-based NLP libraries(Hugging Face), we extract sentiment from individual survey responses and sort them into positive, negative, and neutral categories. Each response is linked to its corresponding SPOT survey question, giving insight into specific areas of course performance. Clustering algorithms are then used to group related feedback and create visualizations that show sentiment trends across various questions. These graphs, along with organized text responses, will be shown in the front-end interface for quick and simple analysis.All collected data is stored in MongoDB to ensure scalability, persistence, and security. A custom sorting algorithm helps organize the feedback for quick presentation. The system has a secure, user-friendly web portal where Virginia Tech professors can log in with their VT credentials, upload SPOT survey files, and immediately view categorized responses, question-level sentiment summaries, and sentiment-based graphs. These results will be saved and viewable to the professor forever, unless deleted by the professor themselves. This is useful because they can see semester by semester improvements. This end-to-end system lets faculty to gain meaningful insights from large volumes of student feedback, making the SPOT process more impactful.We envision broader applications of this tool in other universities and educational environments to support teaching development, instructional quality, and learning experiences at scale. An alpha release with full backend and frontend integration is currently in progress.

Mentor(s): David Gray, COE, Virginia Tech

Abigail Detloff
Virginia Tech/Microbiology

Identifying Potential Protein-Protein Interactions Along Bacterial Spore Inner Membrane

Bacterial spores can be dormant for many years, and, through spore germination, can become metabolically active again within minutes. Some spore-forming species have toxic properties that make them disease-causing. Spores are difficult to kill due to their resistance to heat, chemicals, and layered physical assault, contributing to disease spread. One key component of spores' layered structure is the inner membrane, separating the spore core and cortex, which limits permeability of chemicals to enter the core. A lipoprotein complex exposed on the membrane's outer surface has been shown to stabilize the inner membrane. We now look to determine any interactions between these lipoproteins and other germination-active proteins that contribute to the stabilization of the membrane and germination ability.
This was accomplished by the construction of bacterial two-hybrid plasmids, followed by cotransformation of these new plasmids into E. coli. Both qualitative and quantitative assays of strain phenotypes were performed to identify any protein-protein interactions. The qualitative assay results have not produced apparent indications of protein-protein interactions. However, results from quantitative analysis demonstrate possible weak interactions between the lipoproteins and between specific domains of each protein. To test these interactions further, we will carry out repetitions for the most hopeful results and assay of results at extended time points. In future studies, additional methods of identifying protein interactions, such as protein crosslinking, will be used to verify specific protein interactions.
Work accomplished throughout this project can be used to understand more about spore resistance and germination. When the cell goes through germination, it becomes weakened and much easier to attack, and figuring out what types of interactions allow the most efficient germination will point to possible means of attack on the weakened cells and further prevention of infection/disease.

Mentor(s): David Popham, Department of Biological Sciences, Virginia Tech

Sindhu Dhaveji
Virginia Tech/Clinical Neuroscience
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Virginia Tech/Cognitive and Behavioral Neuroscience
Carolyn Jones
Virginia Tech/Cognitive and Behavioral Neuroscience

Exploring the behavioral and neural impact of musical theater on individuals with neurodevelopmental disabilities

Engagement in dance and music has been linked with improved mental and social health; however, little has been done to investigate the impact of these art forms on individuals with neurodevelopmental disabilities, who often experience difficulties with social communication and relationship-building. We utilized musical theater – a multimodal art form that combines movement, speech, music, and social interaction – to improve socio-emotional functioning in individuals with neurodevelopmental disorders and examine how the experience impacts intra- and inter-brain synchrony. In partnership with STEP VA, an organization empowering people with disabilities through musical theater training in Fredericksburg, VA, 14 individuals with neurodevelopmental disabilities wore mobile electroencephalography (EEG) caps (32 channels, 500 Hz sampling rate) during the final rehearsal of a four month training program for You're A Good Man, Charlie Brown. Self-reported mental health assessments administered before and after the 4-month intervention showed a significant increase in freedom from anxiety (Piers-Harris Self-Concept Scale; $z = -2.236$, $p = 0.025$) and decrease in overall anxiety and total internalizing (Revised Children's Anxiety and Depression Screening; $z = -2.375$, $p=0.018$). Furthermore, utilization of arts-based practices increased quality of life ($r = 0.795$, $p = 0.010$), self-concept ($r = 0.701$, $p = 0.035$), and social connectivity ($r = 0.826$, $p = 0.006$; Emotional Regulation Strategies for Artistic Creative Activities Scale). Our next step will be analyzing the EEG data, focusing on the relationship to the behavioral outcomes to determine if musical theater is an effective non-pharmacological intervention for enhancing mental health in individuals with neurodevelopmental disorders.

Mentor(s): Julia Basso, Human Nutrition, Foods, and Exercise, Virginia Tech
Noor Tasnim, Translational Biology, Medicine, and Health at Virginia Tech

Sara Do
Virginia Tech/Biological Sciences

Loss-of-Function of PERM1 in Skeletal and Cardiac Muscles of Systolic Heart Failure

Heart failure (HF) is a cardiac disease with systemic complications, affecting over 64 million people globally with 50% of patients dying within 5 years of diagnosis. Cardiac cachexia, characterized by severe, irreversible weight loss due to cardiac dysfunction, is a major predictor of mortality in HF. The initial phase of cardiac cachexia occurs as skeletal muscle wasting, further exacerbating cardiac dysfunction and enabling a vicious circle between the heart and skeletal muscle, impacting metabolism. The overarching hypothesis is that gene delivery of Perm1 prevents the development of cardiac cachexia during the progression of HF. We previously demonstrated that Perm1 (PGC-1 and ERR regulator in muscle 1), is a striated muscle-specific regulator of energy metabolism and is predominantly expressed in the heart and skeletal muscle. Perm1 is downregulated in the human and mouse failing heart and loss of Perm1 in mice leads to reduced contractility and energy reserve in the heart, in association with impaired mitochondrial energetics and altered metabolomic profile. However, the role of Perm1 in both muscle types in cardiac cachexia development remains unclear. In mice models, HF induced by transverse aortic constriction (TAC) led to downregulation of Perm1 in both heart and skeletal muscle, which was presumably through adrenergic overstimulation (hallmark of HF) via phenylephrine. Overall, this study suggests that Perm1 downregulation in skeletal muscle under hemodynamic stress contributes to energy dysfunction, potentially initiating the inter-organ cross-talk between the heart and skeletal muscle during HF progression.

Mentor(s): Junco Warren, HNFE, Virginia Tech

Ted Docev
Virginia Tech/Geosciences

Microplastics Accumulation and Storage through the 20th Century to Present in Salt Marshes of the Eastern Shore, Virginia

Salt marshes are important carbon sinks, provide ecosystem services, and provide a buffer from storm surges. Salt marsh vegetation and sediment can also filter and absorb pollutants, making sedimentary sequences effective recorders of pollution through time. Some of these pollutants include: microplastics (particles <5 mm), tire wear particles (TWRPs), pharmaceuticals, and heavy metals. Our focus, microplastics, are major pollutants found in sediment, groundwater, and aquatic animals. How can we predict the ability of salt marshes to trap and store microplastics through time and what kind of microplastics can we expect to find in sedimentary sequences? To answer this question, we took sediment cores from Saxis Marsh (bayside) and Wallops Marsh (oceanside) in Accomack County, Virginia, from a depth of 0 to 90 cm. Cs137 and Pd210 analysis suggests the sediment record below 25 cm pre-dates the introduction of plastics in the mid-20th century. Microplastics extracted in both marshes show a dominance of fibers over particles (fragments, pellets, beads). Concentration decreases with depth in Saxis Marsh (~10.8 fibers/g and ~2.3 particles/g at the top; ~5.7 fibers/g and ~0.47 particles/g at the bottom), while the concentration in Wallops Marsh shows no apparent pattern with less overall microplastics (<1 particle/g throughout). Common polymers are expected to include polystyrene (PS), polyethylene terephthalate (PETE), and nylon. The presence of microplastics downcore prior to the introduction of plastics in the mid-20th century indicates that microplastics have migrated downcore. This shows that salt marshes may be important microplastic sinks, trapping the pollutants in their porous substrate.

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

Sophie Dodge
Virginia Tech/Human Development

Influences on Verb Conjugation in Late Talkers

Most children around the age of 2 have a working vocabulary of about 50-200 words. For children who produce under 50 words, they are considered late talkers. Late talkers are considered to have very limited speech and word understanding compared to typically developing children. This study analyzes the effects of development between late talkers (LT) and typically developing (TD) children in terms of verb conjugation. Verb conjugation can be considered present when the subject is trying to convey different meanings in speech. Including fundamental grammatical elements such as tense, plurality, and the subject. Speech samples were collected from 20 different children, ranging from 30 to 54 months, with a 50/50 split in terms of developmental levels, LT and TD. Once the data was collected, we generated a mixed effect logistic regression model, with the conjugation of the verb as the dependent variable. Other variables tested include development of the speaker, gender, frequency of common verbs, and environments following the verbs present. None of the speaker level predictors, gender, age, and development, were significant in the findings. In contrast, the linguistic features were significant, with high frequency verbs more likely to be conjugated and verbs that precede a pause less likely to be conjugated. I thus conclude that more complex sentences, with full phrases and direct objects, are more likely to feature a conjugated verb for both late talkers and typically developing children.

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

Sebastian Dominguez-Ruiz
Virginia Tech/Mechanical Engineering
Ty Stephens
Virginia Tech/Mechanical Engineering
Bhargav Vasireddy
Virginia Tech/Computer Science
Aditya Singh
Virginia Tech/Computer Science

Interpretation of Non-verbal Communication in Automotive Contexts

Communication between drivers in our current day in age remains in a primitive state with there only being the horn to communicate intent on the road. Our project aims to improve car horn systems by enhancing driver communication through non-verbal means. We seek to enable drivers with more sound choices that vary in tone that allow users to convey more messages applicable to most driving situations. To achieve this, we have developed a system with six distinct horn noises to be played in a variety of situations in hopes of making driving safer by providing communication options to the driver. In this research project, we are looking to understand how different non-verbal auditory signals can be used to communicate in response to common automotive interactions. We ran an experiment interviewing Virginia Tech students to see which sounds they would select for certain driving scenarios. For this, the team used Adobe Premiere to display driving scenarios and play horn sounds and developed an Arduino-based platform with buttons for user input. During these trials, respondents were asked about why they chose the sounds they did and what they thought they meant. Upon analysis of the data, we found that two of our horns were ineffective in providing a distinct message, with the remaining four being agreed upon by our participants to be viable communicators of intent. We are currently administering a survey focusing on sound design, presenting simple sounds without driving scenarios, to obtain quantitative data and learn more about how we can better design sounds for a non-verbal driver communication system. From these results we will refine our sound palette. The next phase of testing should be to repeat the original experiment and then use the results of this experiment to determine if a recipient of the message understands the driver's intent.

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

Katelyn Domke
Virginia Tech/Biochemistry

The Impact of Fluid Properties on the Feeding Performance of Mosquitoes

Mosquitoes are the deadliest animal in the world due to the diseases they vector. Female mosquitoes of some species feed on blood to help develop eggs. They feed on a wide range of hosts that have different body temperatures. Little is known about how blood feeding evolved among mosquitoes and the challenges associated with it. Different temperatures of blood have different viscosities, likely resulting in different feeding performances. This experiment seeks to determine how blood temperature and viscosity affect mosquito feeding habits by measuring the mosquito body temperature during feeding using a thermographic camera and calculating feeding duration. Here, Aedes aegypti and Culex quinquefasciatus mosquitoes were fed on blood at 27°C, 32°C, 37°C, and 42°C, representing a range of hosts from cold-blooded to warm-blooded hosts. We found that both species present with heterothermy at all temperatures, as indicated by the head being the warmest body segment, followed by the thorax, then abdomen. Aedes aegypti generally had lower body temperatures than Cx. quinquefasciatus at all temperatures. This species fed for two minutes on average at all tested temperatures, while Cx. quinquefasciatus fed for about nine minutes at cooler temperatures and three minutes at warmer ones. Understanding how mosquitoes adapt to different types of blood meals is an important step towards deciphering how blood-feeding evolved in mosquitoes and developing tools for their control.

Mentor(s): Chloé Lahondère, Biochemistry, Virginia Tech

Fiona Dreesbach
Virginia Tech/Microbiology

The effect of secondary metabolite diversity on pathogen evolution

Plants produce an array of chemicals called secondary metabolites. Although these metabolites are known to serve many functions, such as pathogen defense, it's still unknown why plants produce a diverse set of chemicals rather than a few more potent chemicals. One hypothesis is that the complexity of multiple compounds may be more effective in slowing the evolution of pathogens to individual metabolites with only a single mode of action. To test this hypothesis, Penicillium expansum, a fungal pathogen that impacts apples post-harvest, was grown over generations to examine the impact of secondary metabolites on the evolution of the pathogen. The fungus was grown in 96 well plates containing mycological broth with different solutions of secondary metabolites common in apples varying in diversity and richness, including 14 single compounds and 45 solutions containing combinations of the individual metabolites. The growth was measured over five days by a plate reader at 8 am and 8 pm daily. After each generation, the spores from each well were counted then diluted to a constant of 120 spores per 1 microliter of solution, and transferred to sterile plates for the next generation. To examine the evolution of the pathogen, this process was repeated for seven generations and will be continued until reaching 10. Preliminary results suggest a relationship between increased structural diversity of secondary metabolites and preventing rapid evolution of pathogens. These results inform our understanding of the origins of secondary metabolite diversity and can be applied to improve the management of plant pathogens.

Mentor(s): Dorothea Tholl, Biological Sciences, Virginia Tech
Susan Whitehead, Biological Sciences, Virginia Tech

Carlos Dubon Hinojosa
Virginia Tech/Animal & Poultry Sciences

Types of Adaptive Bird Feeding Equipment Used By Individuals With Accessibility Challenges

In the United States, over 96 million people participate in bird-related activities. However, individuals with accessibility challenges or disabilities may benefit from adaptations like special equipment to help with bird-feeding–related tasks. To improve inclusion and accessibility in conservation and outdoor recreation, the Dayer Human Dimensions Lab at Virginia Tech partnered with the Cornell Lab of Ornithology and Birds Canada's Project FeederWatch, a participatory science project focused on backyard bird feeding, to explore how people with disabilities adapt to bird feeding. Using surveys distributed to Project FeederWatch participants, we collected data on participant demographics and the adaptations employed to facilitate bird feeding. Our analysis focused on responses from individuals who self-identified as disabled, neurodivergent, or experiencing accessibility challenges with vision, hearing, cognition, mobility, mental health, chronic illness, or other conditions. Through inductive coding, we identified common response themes.
This study presents findings on the types of adaptive equipment used to enhance accessibility in bird feeding. Our findings suggest that bird feeders with adaptive features, especially those easy to open, fill, and clean, are more accessible for bird feeding. Also common was optical equipment, such as binoculars, which assist individuals with visual disabilities. Moreover, their widespread use in birding and wildlife viewing highlights how adaptive tools can benefit individuals with disabilities and the general public. Lastly, adaptive hardware such as hanging systems, extended-reach tools, and positioning aids aided physical interaction with bird feeders. By identifying these adaptations, conservation organizations and birding communities can better support the needs of individuals with disabilities.

Mentor(s): Kelley Langhans, Fish and Wildlife Conservation, Virginia Tech
Freya McGregor, Department of Fish and Wildlife Conservation, Virginia Tech
Dr. Kelley Langhans, Department of Fish and Wildlife Conservation, Virginia Tech
Dr. Ashley Dayer, Department of Fish and Wildlife Conservation, Virginia Tech

Nathaniel Dunlap
Virginia Tech/Computer Science
Adonnai Wobante
Virginia Tech/Neuroscience - Behavioral and Cognitive
Madison Bui
Virginia Tech/Cybersecurity Management and Analytics

The effects of Allura Red AC on the gut microbiota

Allura Red AC, otherwise known as red 40, is an azo dye which is commonly used as a food additive in processed foods, and is the most popular red dye in the United States. Azo dyes are a type of synthetic dye that have become a widespread ingredient in food in the past several decades. Because red 40 has been shown to cause bowel diseases in mice which resemble colitis in the human body, there is a need to better understand the effects of long term consumption of this dye on humans. Current studies highlight the importance of testing whether the dye has the same negative effects on humans as it does on mice. The goal of this study is to find out whether a diet including red 40 leads to a decrease in the biodiversity present in the human gut microbiome. Our proposed study will consist of a control group with a diet without red 40 as well as a test group with a diet including the ADI (Acceptable Daily Intake) of the dye. Stool sample collection and examination will be used to determine the effects of artificial food dye additives to the human microbiota. The anticipated results of the stool samples could show signs of early colitis, decrease in crucial bacteria diversity, and inflammation of the digestive tract and could suggest that regulating bodies need to lower the ADI to a more acceptable level.

Mentor(s): Amanda MacDonald, University Libraries, Virginia Tech

Luke Dutton
Virginia Tech/Environmental Resource Management

Stress and Participation in Outdoor Adventure Programming

Outdoor recreation, education and adventure programming is a widely growing field that's benefits are well-understood. These benefits include, but are not limited to improvement in leadership skills, sense of community, self-identity development, mindfulness, and subjective well-being. This study specifically investigates the efficacy of outdoor education and adventure programming as it relates to college students' stress in the weeks leading up to and following participation in the program. Pre and post-participation stress surveys were conducted using respondent's self-perception to gather results. Additionally, open-ended questions were used in the post-participation survey to gain further insight into the nature of participants' experiences both related and unrelated to stress. Overall, respondents of the survey displayed lower levels of stress in the two weeks following participation in the program, as opposed to the two weeks before, and expressed the positivity of their experiences both within and outside the scope of stress in open-ended questions. Generalizability of the results of this study to larger populations is greatly limited by sample size and volunteer bias.

Mentor(s): Anja Whittington, FREC, Virginia Tech

Elene Dvali

Virginia Tech/Clinical Neuroscience

The Effects of Urbanization and Brood Parasitism on Neuropeptide Y (NPY) Protein Abundance in Song Sparrow (Melospiza melodia) Nestlings

Authors: Dvali, L.; Fossett, T.; Kaul, S; Lane, S.; VanDiest, I.; Sewall, K.

Urbanization creates challenges that wildlife must overcome. One challenge associated with urbanization is more frequent brood parasitism by the brown-headed cowbird (Molothrus ater). Cowbirds lay their egg(s) in another species' nest and rely on the host to raise their offspring, often causing nutritional stress, reduced growth rate, and lower survival of host offspring. Nutritional stress during early life can organize the brain to shape adult behavior, however, there is little work investigating the effects of brood parasitism on the brain and behavior of host offspring. In adults, nutritional stress increases aggression and is also linked with the release of neuropeptide Y (NPY), an orexigenic peptide and neurotransmitter that promotes foraging and antisocial behaviors. This raises the hypothesis that nutritional stress during development via brood parasitism organizes the NPY system to promote aggression in adulthood. Here, we investigated the effects of brood parasitism and associated early life stress on NPY protein abundance in the hypothalamus (both paraventricular nucleus and infundibular nucleus) of developing urban, urban and brood parasitized, and rural nestlings using immunohistochemistry. We found that NPY levels vary by nestling age and developmental condition. Future work will include comparisons of behavior and brain processes in adulthood.

Mentor(s): Kendra Sewall, Department of Biological Sciences and Department of Neuroscience, Virginia Tech
Taylor Fossett (graduate student mentor), Department of Biological Sciences, Virginia Tech

Elayna Ealy
Virginia Tech/Environmental Conservation and Society

Microbial activity as a driving factor of organic compost effects on the growth of Plectosporium tabacinum

Plectosporium tabacinum is a soilborne plant pathogen affecting cucurbit crops worldwide. Organic matter can stimulate microbial communities by supplying nutrients and can also affect the density of plant pathogens in the soil. In this study, we evaluated how different compost sources and microbial communities affected the spatial growth of P. tabacinum. Compost treatments included: soil only (no compost control), animal compost, plant compost, mixed compost, and worm compost. Compost microbial community treatments included unsterilized and sterilized compost. Each treatment combination was replicated 5 times (n=45). P. tabacinum and the compost treatments were added to large petri dishes (150 mm diameter) and incubated for 7 days, then sampled for pathogen presence using a petri dish spatial divider to determine pathogen growth. Enzyme activity was then measured to determine how chitin (β-D-glycosaminidase) and cellulose (β-glucosidase) degrading enzymes influenced pathogen growth. Soil slurries were created from the media in each petri dish for the two enzyme assays. The samples were then measured using black 96-well plates receiving one of the different substrates containing a fluorescent compound. Plates were incubated for four hours and then evaluated using a microplate reader. It is hypothesized that the unsterilized treatment groups will increase microbial enzyme activity, because of the naturally occurring microbial communities within the compost.

Mentor(s): Ashley Jernigan, School of Plant and Environmental Sciences, Virginia Tech

Rayah Edelson
Virginia Tech/Plant Science

Characterizing amino acid toxicity in Arabidopsis and the relief by Glutamine

Amino acids are well known as building blocks of proteins, but they also play a central role in plants by being used as precursors of secondary metabolites and as nitrogen carriers. Yet, excess of specific amino acids is toxic to plants, likely by disturbing the amino acid balance in the cells. Results from Bonner et al. using tobacco cells have shown that amino acid toxicity is relieved by the non-toxic amino acid glutamine, but the precise molecular mechanisms are not known. The aim of this research is to characterize the effect of glutamine on the regulation of amino acid metabolism using the model plant Arabidopsis, for which a vast amount of information and tools are available. We first started by identifying which amino acids are toxic, at which concentrations and if glutamine alleviates their toxicity. For this purpose, Arabidopsis plants were germinated on solid medium, transferred to liquid medium in 48-well plates, and treated with amino acid mixtures. After several days of growth, plants were scanned, dried and weighed to create dose-response curves. The results showed that glutamine does relieve toxicity in Arabidopsis, and that it is the only amino acid with this effect. This suggests that glutamine may influence regulatory pathways that control the activity of amino acid biosynthetic enzymes. We hypothesize that TOR, the well-known positive regulator of the metabolism, is involved in the response. This research could help improve amino acid metabolism to produce more resilient or more nutritive crops.

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

Zacarya Elbash
Virginia Tech/Neuroscience

Effects of GLP-1 agonists in people with obesity during alcohol consumption

Background: Glucagon-like-peptide-1 (GLP-1) agonists, approved for weight loss and diabetes, show promise in reducing alcohol intake in preclinical studies. Research is needed to clarify mechanisms and confirm efficacy.
Objective: Investigate differences in acute alcohol response between individuals with obesity on GLP-1 agonist and control not on GLP-1 with obesity.
Methods: Participants on GLP-1 agonists (n=10) or control (n=10), with matched BMI (≥30) and AUDIT-C (1-6) completed an alcohol session with three drinks targeting a maximum breath alcohol concentration (BrAC) of 0.1 mg/dl in 60 minutes based on weight. BrAC and subjective feeling of drunkenness were measured before, after, and every five minutes.
Result: Significant group-by-time interaction for BrAC ($\chi2(7)=16.36$, $p=0.022$, $f=0.36$) such that BrAC rose slowly for the GLP-1 group. BrAC was lower in GLP-1 group compared to control at time points following initial drink (10, 15, and 20 minutes, all adjusted p-values < 0.05), this was not seen at later time points. Similarly, subjective feelings also differed across time between groups ($\chi2(8)=222.30$, $p<0.001$, $f=1.24$). No differences in rated nausea across groups or positive/negative effects of alcohol were observed.
Conclusion: Participants with obesity who occasionally drink and are on GLP-1 medications showed a slower rise in BrAc following an acute alcohol challenge compared to those not on GLP-1 medications. Slower rise was accompanied by altered subjective experiences, potentially due to delayed gastric emptying. Larger studies are needed to confirm these findings.

Mentor(s): Fatima Quddos, TBMH graduate student, Virginia Tech

Austin Ellis
Virginia Tech/Dairy Science

The effects of black soldier fly larvae meal on in vitro rumen fermentation characteristics and bacterial abundance

Protein is one of the most expensive nutrients in dairy cows' rations; therefore, there has been an increased interest in alternative protein sources such as insect meal (IM). This study aimed to determine the influence of incremental levels of IM on in vitro rumen fermentation profile and bacterial abundance. Rumen fluid was collected from two mid-lactation, multiparous cannulated dairy cows (~142 DIM). Then, filtrated rumen fluid was diluted in Goering and Van Soest buffer under CO_2 flux. Buffered rumen fluid (20 mL) was added to test tubes and assigned to one of the treatments (DM basis): T1, 100% TMR (containing 200 mg of TMR); T2, 97.5% TMR + 2.5% IM; T3, 95% TMR + 5% IM; T4, 92.5% TMR + 7.5% IM; T5, 90% TMR + 10% IM. The test tubes were closed and placed in an incubator (39 °C) with a shaking system set at 80 rpm for 0, 3, 6, 12, 24, and 48 h. Incubation was terminated by placing test tubes on ice. The pH of all samples was measured immediately following termination and then frozen (-80°C) for later analysis of VFA, in vitro DM digestibility (IVDMD), bacterial abundance, and NH_3. Bacterial abundance was determined via RT-qPCR methods. A sample of IM was analyzed for CP (39.0%) and fat (39.8%). Data were analyzed using the MIXED procedure of SAS with preplanned orthogonal contrast to test linear and quadratic effects over the incremental levels of IM. A linear increase in NH_3 ($P = 0.05$) and valerate ($P = 0.02$) was observed across IM levels. In contrast, acetate ($P = 0.01$) and IVDMD ($P < 0.01$) linearly decreased over IM levels. A trend ($P = 0.09$) for a linear decrease in propionate was observed. There was a linear increase ($P = 0.02$) in the abundance of Butrivibrio proteoclasticus as the IM levels increased. Similarly, a trend ($P = 0.07$) for a linear decrease in Anaerovibrio lipolytica was observed. NH_3 and valerate increases suggest an increased rate of protein degradation. High fat content in IM may have contributed to the decrease in IVDMD, VFA, and some bacteria. These results suggest that IM with lower fat content may be more suitable for supplying protein while maintaining adequate rumen fermentation.

Mentor(s): Johan Osorio, School of Animal Science, Virginia Tech
Tatian Fernandes, School of Animal Science, Virginia Tech

Nicole Endres
Virginia Tech/National Security & Foreign Affairs
Samantha Boyer
Virginia Tech/National Security & Foreign Affairs

Russia’s Use of Gendered Disinformation as a Tool of Hybrid Warfare Against the United States

"This study aims to examine how gendered disinformation functions as a form of soft power in Russia’s broader geopolitical strategy. By framing gender equality and LGBTQ+ rights as existential threats to “traditional values,” Russian state and non-state actors manipulate public discourse to weaken trust in democratic institutions and fuel polarization in the U.S. and allied nations. This strategy is part of a broader geopolitical approach that relies on information manipulation and cultural narratives, rather than direct military conflict.
This research seeks to highlight historical patterns of ideological warfare in Russia that are often overlooked in realist interpretations of international conflict. Just as past regimes leveraged cultural anxieties to expand their influence, contemporary attacks on democratic freedoms—under the guise of defending tradition—serve as a slippery slope toward broader authoritarian encroachments. Understanding these strategies is essential for recognizing the role of social and cultural narratives in modern hybrid warfare and their implications for global power dynamics.
To conduct this research, we used a rhetorical analysis approach. We drew from a range of sources in both English and Russian, including media reports, scholarly literature, government documents, legal texts, case studies from the U.S. and Italy, and data from online databases.

Mentor(s): Trevor Wilson, Department of Modern and Classical Languages and Literatures, Virginia Tech

Elizabeth Eroshenko

Virginia Tech/Environmental Science

Indicator Bacterium Survival Peaks in Brackish Waters

The goal of this project was to determine a threshold for salinity effects on the survival of Escherichia coli, an indicator bacterium for waterborne pathogens in environmental waters such as streams and rivers. Historically, E. coli has not been used as an indicator bacterium in brackish or marine water because previous research have shown decreased E. coli survival at higher salinity. However, recent research has shown that as freshwater salinity increases due to human activities such as deicing and agriculture, the survival rate of E. coli also increases. But it is unclear within the brackish range (about 1500 to 45000 µS/cm) where the effect of salinity on E. coli changes from positive to negative. Finding this break point was the goal of this experiment. Our hypothesis was that as brackish salinity increases, the survival rate of E. coli will increase, but then drop off at a certain point. To test this, microcosms of water ranging in salinity within the brackish range was inoculated with E. coli K12 and the concentration of bacteria was be sampled over the span of three weeks to determine the decay rate. The results showed that the concentration of E. coli peaked at 5000 µS/cm before declining. This transition from increasing to decreasing survival is likely due to a shift from hypo- to hyperosmotic stress. As brackish ecosystem salinities increase due to climate change and changes in water use, E. coli may become a more inaccurate indicator of health risks if waterborne pathogens respond differently.

Mentor(s): Brian Badgley, School of Plant and Environmental Science, Virginia Tech
Dr. Meredith Steele, SPES, Virginia Tech

Elizabeth Eroshenko
Virginia Tech/Environmental Science

Evaluating the Financial Landscape of Soil Judging Programs

Collegiate soil judging is an academic competition that allows students to evaluate soil profiles, interpret soil properties, and analyze land use suitability. Through this hands-on experience, students gain practical knowledge in soil science, enhancing their skills in observation, analysis, teamwork, and decision-making. However, despite its educational benefits, many soil judging teams face significant financial barriers that prevent them from fully participating in competitions. The costs associated with travel, lodging, and competition fees can be prohibitive, especially for teams from smaller or less-funded institutions. This lack of financial support not only limits students' opportunities to engage in these enriching experiences but also creates disparities in access to professional development and networking opportunities within the field of soil science. A nationwide survey was conducted to assess the financial standing of soil judging teams across the country, in order to identify the key financial challenges faced by these teams and to explore potential strategies for improving funding and support. Results showed that one in four soil judging coaches have limited the number of students who traveled to a contest due to financial limitations. Half of teams cannot attend two contests per year unless the contest happens to be nearby geographically, or if they spend significant time and effort fundraising. Half of the responding teams ask their students to pay some of the costs associated with attending contests, with an average out-of-pocket cost of $80. Coaches are burdened with finding funds while also spending an average of 3-6 hours per week training students, though less than half of them are compensated for that effort. Many coaches, both head coaches and assistant coaches, are donating their time.

Mentor(s): John Galbraith, School of Plant and Environmental Science, Virginia Tech
Jaclyn Fiola, Plant Science and Landscape Architecture, Delaware Valley University

Dia Ferrufino
Virginia Tech/Mathematics

How Studying Dead Languages Can Help Preserve Indigenous Languages

After their colonization, indigenous communities in South America realized that assimilation to the colonial ideologies imposed on them was necessary to survive in their new society. This prompted many natives to adopt European standards of aesthetic and education, forgoing cultural identities such as “Colla” for “Bolivian”, or “Mapuche” for “Chilean”. Centuries later, we see the harm this homogenization has caused native languages. Early on, indigenous languages were outlawed, but even after these prohibitions were lifted, speaking them was often associated with poverty, ignorance or barbarism. These outlooks resulted in severe damage, and many languages were eradicated completely. However, there is hope for preserving the tongues we still have. Consider Latin or Ancient Greek, languages that aren’t spoken anymore but continue to be taught. The media of the modern Western World, stories, art, language, have been heavily shaped by classical works. Scholars of these fields study classics—including, of course, dead languages—to understand our culture today. This is similarly true of indigenous cultures to their respective South American countries. Dead languages make good practice for learning other languages because they are generally studied in a near scientific way. Since they aren’t spoken, understanding conjugation charts, declensions, sentence structure–the nuts and bolts of a language–are more important to a student of classical languages. We can see the rings of the metaphorical tree trunk, and take note of patterns across languages via autopsy. This type of study can be adapted to help better document indigenous languages and preserve them for future generations.

Mentor(s): Andrew Becker, Department of Modern and Classical Languages, Virginia Tech

Reid Flessa
Virginia Tech/Environmental Resources Mangement

Phosphorus Dynamics in Intensively Managed Loblolly Pine Stands (P. taeda L.): Insights from Annual Growth Rings

Loblolly pine (Pinus taeda L.) is the most widely grown and intensively managed tree species in the United States, with over 14 million hectares planted across the Southeast. In much of its range, phosphorus (P) is a limiting nutrient, often requiring supplemental fertilization to support growth. This study aims to determine whether annual tree rings can be used to assess P accumulation following a one-time fertilization. We sampled five-year-old loblolly pine trees from the Coastal Plain of Nassau County, Florida. Eight trees were sampled per treatment group: a control (no fertilizer) and three P application rates: Low (40 kg P ha^{-1}), Medium (81 kg P ha^{-1}), and High (121 kg P ha^{-1}).Of the eight cores per group, three will be separated into individual annual rings for year-by-year analysis, while the remaining five will be analyzed as whole-core samples. All samples will be processed using inductively coupled plasma mass spectrometry (ICP-MS) to measure concentrations of P and calcium (Ca), the latter serving as a relatively immobile reference element. This method enables analysis of interannual P accumulation in stems and variation among trees within treatments. We hypothesize that stem P concentrations will increase with fertilization rate. The findings will inform silvicultural decisions related to fertilization timing, rates, and long-term nutrient management at both the stand and regional levels.

Mentor(s): Brian Strahm, Forest Resources and Environmental Conservation (FREC), Virginia Tech
Dan Hong, PhD Candidate Dept. of Forest Resources and Environmental Conservation, Virginia Tech

Sofia Forbes
Virginia Tech/Microbiology and Biochemistry

Interactions of Flagellotropic Bacteriophages with Various Agrobacterium Species

Flagellotropic bacteriophages (phages) depend on rotating host flagellar filaments for infection. This study investigates the interactions between flagellotropic phages and their Agrobacterium hosts. We focused on three phage-host pairs: phage Milano and host Agrobacterium tumefaciens strain C58, phage 7-7-1 and host Agrobacterium sp. H13-3, and phage OLIVR4 and host Agrobacterium tumefaciens strain 15.13/040. Although phages are typically highly host-specific, we did observe cross-infectivity among certain Agrobacterium species and phages in spot assays. We used swim ring assays to test whether flagellins from different Agrobacterium species can complement across species. Understanding these interactions is crucial for developing phage-based biocontrol strategies, providing significant information for clinical and agricultural applications.

Mentor(s): Birgit Scharf, BIOL, Virginia Tech
Abigail Horton, Virginia Tech

Ella Forsythe
Virginia Tech/Biology

Chronic Low Level Stress in Zebrafish

Zebrafish are sensitive to environmental factors such as pH and show higher stress levels when in a slightly acidic environment. We want to test if being raised in a slightly acidic environment is stressful for zebrafish and if it has an impact on brain development. To measure stress levels we quantified cortisol and the expression of Crhb+ cells in the NPO, a key part of the stress axis. We expect chronic, low levels of stress to show an increase in cortisol and an increase in Crhb+ cells in the NPO. This is measured using ELISA and In situ hybridization, respectively. Zebrafish deficient in the Dscaml1 gene, which is directly linked to the formation of the stress axis, showed that Dscaml1 mutants have increased basal cortisol levels and decreased programmed cell death. Using this new chronic stress model, we plan to test the link between cortisol and programmed cell death. Chronic stress in zebrafish due to a slightly acidic environment can be used as a model to help understand how low levels of chronic stress impact brain development in humans.

Mentor(s): Albert Pan, Neuro, Virginia Tech

Connor Fowlkes
Virginia Tech/Environmental Conservation and Society

Brush Mountain Trail Monitoring Study

This study aimed to research the long-term impact of mountain biking on McDonald Hollow, located in Brush Mountain Park in Blacksburg, Virginia. This project continued a study conducted by Matthew Lindsay (then a graduate student in Forest Resources and Environmental Conservation) in 2021-2022. During the initial project, Matt set up permanent trail transects to monitor the trail condition and erosion over time. The current study established a long-term trail monitoring project to understand how the trail condition eroded or maintained its surface over time. In the fall of 2024, 64 transects were reevaluated to know how these trails fare from their initial creation. This was done by measuring each of the transects' depth from an anchor point across the trail. This allowed us to understand the depth of the trail and whether it has changed over time. As water, trail users, and others use the trail, the soil will erode, meaning it will be either washed or kicked away. This will push the trail lower into the ground. The depth measurement done at the permanent plot can be re-assessed to see whether any erosion has occurred over time. The current study looked at impacts to soil, whether there is a difference between types of trail tread, and overall tries to answer whether these trails have been impacted by human use, have maintained their durability, or eroded over time.

Mentor(s): Anja Whittington, Forest Resources and Environmental Conservation, Virginia Tech

Jacqueline Frank
Virginia Tech/Biochemistry
Sophie Stanley
Virginia Tech/Biomedical and Biological Science
Kaitlin Rath
Virginia Tech/Criminology
Launa Longwell
Virginia Tech/Biological Sciences
Danielle Ingle
Virginia Tech/Physics
Ryan M. Quimby
Virginia Tech/Integrated Agricultural Technologies

Light Pollution: How Sky Quality Impacts the Safety Perception of Blacksburg

According to the National Park Service, the primary cause of light pollution is outdoor lighting that emits light upwards or sideways. At Virginia Tech's Blacksburg campus, over 650 uniform streetlights contribute to this issue, as they are all unshielded. Uplighting—light emitted upwards—is particularly noticeable in the streetlamps surrounding campus. While reducing light pollution is crucial, so is maintaining students' perceptions of safety. This research aimed to answer the question: How can we reduce light pollution while maintaining people's perceptions of safety in Blacksburg, Virginia? To explore this, a five-question survey was distributed both electronically and through posters. Additionally, the sky quality (SQM) was measured at three campus locations with varying light levels, and images from these locations were included in the survey. Participants rated their perception of safety on a scale from one to five for each image of lighting on campus. Survey results indicated that the brightest location was perceived as the safest, while the dimmest was seen as the least safe. These findings align with expectations, as higher light levels generally correlate with greater feelings of security. However, they also highlight the challenge of balancing safety perception with the need to minimize light pollution. Future research could explore alternative lighting designs—such as shielded or motion-activated lights—that reduce skyglow while maintaining a sense of security. By implementing thoughtful lighting solutions, Virginia Tech and similar communities can work toward reducing light pollution without compromising safety.

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

Anna Caroline Fuller

Virginia Tech/Industrial Design

Team Malawi- Community Based Childcare Centers

This project explores how design can support early childhood development and community engagement within community-based childcare centers (CBCCs) in rural Malawi. The goal is to understand the needs of children, teachers, community supporters and communities in these areas and to design solutions that help to foster nurturing, playful, and incentivize learning environments. The purpose of this research is to address the systemic challenges that community based childcare centers and primary schools face such as limited resources, infrastructure, and educational materials—by applying a human-centered design approach. Our process has so far included research conducted through remote interviews with caregivers and community leaders in Malawi and literature research on concrete statistics and information. The anticipated outcome of the project include a set of modular, low-cost interventions—such as play-based learning tools, infrastructure improvement, or teacher/community support systems—that can be adapted and implemented across CBCCs around Malawi. We also aim to support and assist an existing program, Friends Across Boarders, which has created a Pen Pal program to tackle drop-out rates by encouraging cross cultural learning and improve literacy rates.

Mentor(s): Martha Sullivan, Industrial Design, Virginia Tech

Kileigh Gainer
Virginia Tech/Animal and Poultry Science
Peyton Reed
Virginia Tech/Dairy Science
Makayla Squatrito
Virginia Tech/Neuroscience
Mary Carroll
Virginia Tech/Biological Science
Punya Patel
Virginia Tech/Computer Science

Environmental Factors Influencing Resource-Guarding Dogs

Environmental Factors Influencing Resource-Guarding Dogs
Kileigh Gainer, Peyton Reed, Mary Carroll, Makayla Squatrito, Punya Patel
Word Count: 258

The research project was designed to determine environmental factors that contribute to resource-guarding and reactive dogs. Dogs that are reactive or are resource-guarding have a more stressful life, and this affects the owners as well. These dogs might bark at everything, bite people, and more, which can cause harm to families resulting in physical and mental stress. In finding the different factors for reactive behaviors in the environment of these dogs, owners will be able to best provide for their pets. We will collect the data for this research project by conducting a survey determining the environmental factors that could influence a dog's behavior causing it to become reactive or to resource guard. We created a survey to collect information from dog owners on a variety of factors and their dog’s reactivity. This included dog breeds, age, training methods, other people in the house, etc. Our data analysis showed that there are many environmental factors that dogs are reported to be reactive to. Dogs described as “very disobedient” tended to be self-trained, had bitten people for harm, and barked at outside factors (e.g., cars, people, other dogs). All in all, our data found that 35% of dogs sleep in their own bed and range in obedience levels. Using our survey data, we were able to connect the main factors affecting resource-guarding dogs as well as factors we thought would make a difference but did not. Owners can use data from our research to ensure that both their and their dogs' lives are less stressful and more enjoyable.

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

Shruthi Ganapuram
Virginia Tech/Computational and Systems Neuroscience

Optimizing Low-Intensity Focused Ultrasound (LIFU) Treatment Parameters: Comparative Analysis of Skull Density, Thickness, and Incident Angle in Humans and Canines

The integration of focused ultrasound experimentation can optimize the current understanding of clinically relevant parameters that influence the precision of ultrasound waves for Glioblastoma Multiforme (GBM). GBM is the most common malignant brain cancer, with limited treatment options, making non-invasive, targeted approaches like low-intensity focused ultrasound (LIFU) increasingly important. By conducting a comparative analysis of skull density, thickness, and incident angle in both humans and canines, this study aims to refine ultrasound targeting strategies for more precise therapeutic interventions.

CT datasets obtained from a veterinary clinic are used to examine canine skull characteristics. Using Kranion, a focused ultrasound planning software, we extracted skull thickness, skull density ratio (SDR), and incident angle values. Kranion's interface enables visualization of CT/MRI data, virtual transducer positioning, and region-specific parameter analysis. Data were processed using Python, applying inclusion filters: skull thickness, SDR, and incident angle.

Preliminary findings suggest that applying these parameters enhances the identification of suitable acoustic windows for LIFU. An exploratory SDR threshold of 0.4 in both species revealed the need for further data analysis across additional CT scans to refine skull thickness and SDR ranges. The ultimate goal is to integrate these findings into Insightec's treatment planning systems to support more accurate and species-specific LIFU interventions for GBM.

Mentor(s): Jason Raymond, Focused Ultrasound at Fralin Biomedical Research Institute, Virginia Tech

Ariana Garrastegui Segarra

Virginia Tech/Animal and Poultry Science

K63 Polyubiquitination as a Hippocampal Regulator of Appetite

Currently more than 40% of adults in the U.S. suffer from obesity which is a marked rise from previous decades. Interestingly recent studies have demonstrated obesity to be co-morbid with memory impairments suggesting a connection between the two conditions. One of the primary regions involved in memory formation in the brain is the hippocampus. It has been previously found that ubiquitin-proteasome system (UPS) plays a role in memory formation in the hippocampus. Two of the most well-studied chains in the UPS are K48 polyubiquitin, a protein degradative chain, and K63 polyubiquitin, a canonically non-degradative chain. Our lab has previously shown that K63 polyubiquitin is involved in hippocampal memory formation, however, there is a lack of information regarding how obesogenic diets influence the retention of memory. Throughout this project, the original aim was to manipulate expression of K63 polyubiquitination in the CA1 region of the hippocampus of male rats using a CRISPR-dCas13-mediated knockdown. Then, we would expose the rats to diets with varying fat content for 13 weeks. During the allotted time, we consistently recorded their weight and amount of feed consumed. In the time span of the project, we observed significant differences in feeding behavior between the manipulated and control group. The manipulated group ate significantly more than the control, which suggests that K63 polyubiquitination could potentially play a role in appetite regulation in the hippocampus. Ultimately, the focus of the project shifted towards examining the hippocampal pathways of K63 polyubiquitination pertaining to appetite.

Mentor(s): Timothy Jarome, Animal Science, Virginia Tech

Thomas Garrison

Virginia Tech/Computational Modeling and Data Analytics

Solving the Young-Laplace Equation with Physics-Informed Neural Networks

Solving the Young-Laplace Equation with Physics-Informed Neural Networks

1,2,3 Thomas Garrison, 1,2,3 JC Hartman, 1,2,3 Mason Hill, 1,2,3 Fangzhou Yu, 1,2,3,4 Shengfeng Cheng

1 - Department of Physics, 2 - Center for Soft Matter and Biological Physics, 3 - Macromolecules Innovation Institute, 4 - Department of Mechanical Engineering, Virginia Tech, VA 24061

Fluid-fluid interfaces, including water-air interfaces, play a central role in many wetting and capillary phenomena and processes. Their shape is governed by the Young-Laplace equation, a second-order nonlinear differential equation which relates the local curvature of the interface to the pressure difference across the interface, with the interfacial tension as a material parameter. In cases where the effects of gravity cannot be neglected, the nonlinear nature usually prevents analytical solutions to the Young-Laplace equation. In the past, methods including numerical integration and matched asymptotic expansions have been used to study this equation and approximate formulae have been derived for interface-dependent physical quantities. In this work, a new method based on physics-informed neural networks (PINNs) has been developed to accurately and efficiently solve the Young-Laplace equation in a few settings, including the meniscus on the outside of a circular cylinder, the liquid bridge beneath a sphere detached from a liquid bath, the capillary bridge between two plates, and bubbles floating at a liquid-vapor interface. To this end, the equation is reformulated as an integro-differential equation to make it amenable to PINNs and the boundary conditions suitable for each system are embedded into the loss function. The PINN-based method is used to predict the shape of the meniscus and related physical quantities. The calculated results reveal the accuracy of the approximate formulae. The method can be generalized for handling similar differential equations important in science and engineering.

Mentor(s): Shengfeng Cheng, Department of Mechanical Engineering, Department of Physics, 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, over 5,000 exoplanets have been confirmed, with many thousands more anticipated to be discovered with present and future observatories. This wealth of data calls for a need to efficiently and thoroughly process complex exoplanetary 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 examine the most frequently co-occurring patterns of planet subtypes in several thousand exoplanetary systems and generate association rules. 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 association rules derived from our algorithm to discover and understand the significant associations found in the data. For instance, one of our rules shows that a planetary system with a stellar 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 revealed several significant findings, including rules that predict the presence of cold and long-period gas giants in systems with G-dwarf and M-dwarf stars, despite observational biases against detecting such planets. Additionally, we uncovered patterns suggesting the potential presence of temperate gaseous planets, which are of interest to astrobiology. Overall, this project establishes a valuable and extendable framework for future research, with its predictive power expected to grow along with the continually increasing abundance of exoplanet data.

Mentor(s): Anirudh Prabhu, Carnegie Institution for Science, Virginia Tech
Michael L. Wong, Carnegie Institution for Science, Virginia Tech

Adeline Gaudet

Virginia Tech/Environmental Conservation and Society

Evaluating the environmental preferences and spread of the invasive Asian Jumping Worm (Amynthas Agrestis)

Amynthas Agrestis, also known as Asian Jumping Worms (AJW), are an invasive species native to east-central Asia. AJWs are a destructive species that negatively impact soil habitats and deplete soil organic matter; therefore, it is imperative to understand how their ecology impacts their survival and spread. This study sought to determine AJW environmental preferences, movement over time, and ability to survive over winter in Virginia. The application of mulch, a known cause of AJW spread, occurred on Virginia Tech's agricultural quad on October 7th, 2024. Two sampling events occurred in the fall shortly after mulch application (10/18 & 11/1) and two the following spring (3/27 & 4/8). Four blocks (4 m x 4 m) were established that had different environmental conditions: (1) well drained, shady (2) well drained, mid-day sun (3) moist, shady (4) well drained, early sun. Four random 0.25 m2 quadrats were assessed within each block by sorting through the mulch and disturbing the soil to a depth of 7 cm to identify and count worms. At both fall samplings, AJWs were found only in Block 2. At the first spring sampling, no AJWs were found, but at the second sampling AJWs were found in Block 2 again. These results indicate AJWs may prefer warmer, dryer soil. Also, since they were found again during spring, they were able to survive over winter. These findings increase our understanding of their ecology, which better enables us to effectively stop their harmful spread.

Mentor(s): Ashley Jernigan, School of Plant and Environmental Sciences, Virginia Tech

Lucy Gehman
Virginia Tech/Wildlife Conservation

Virginia Barrier Island System Changes: Landcover Transition Following Hurricane Isabel, 2004-2021

Due to factors resulting from climate change, such as increased storm intensity, higher temperatures and rising sea-level, dynamic barrier island ecosystems are subject to rapid degradation. Healthy barrier islands rely on the disturbance-recovery cycle which supports the islands' structure through overwash, sediment deposition and sporadic migration. During our research, we used ArcPro software to classify island landcover in the Virginia Barrier Island system over the years of 2004, 2009, 2012, 2016, and 2021. The landcover classifications were then assessed by a different technician from the classifier, to confirm a passing accuracy score of 85% or higher. This period of study directly follows hurricane Isabel, a significant disturbance event in this ecosystem during 2003. We anticipate that the observed increase in shrubland on the barrier islands has had a similar effect to coastal development, by limiting overwash, inhibiting island mobility, and diminishing the natural dynamism of the islands. The subsequent landcover changes, including reduction of saltmarsh habitat on specific islands, may have arisen as a result of this loss of mobility. Additionally, the degradation of barrier island habitats reduces available nesting habitat for shorebird populations. Barrier islands also are an important cultural and economic resource. As such, the loss of barrier island habitats has negative implications for communities along the eastern shore of Virginia.

Mentor(s): Sarah Karpanty, Department of Fish and Wildlife Conservation, Virginia Tech

Neil George
Virginia Tech/General Engineering
Trisha Naidu
Virginia Tech/Computational and Systems Neuroscience

Designing a Novel and Effective Childproof Gun Lock for Gun-Owning Families

Our project aims to create a novel and effective gun lock that is child-proof but allows adult owners to access their firearms hassle-free. Unnecessary deaths, especially accidental ones, can vastly be prevented if guns are more securely stored in homes. Starting with our local community in Southwest Virginia, we have researched the types of guns that families most commonly own. These gun types include shotguns, rifles, and handguns. Our final design is modeled around a .22 LR Pistol and consists of a single piece component we 3D-printed. The gun lock clasps around the trigger and opens by utilizing a hinge function. Then, the gun is secured by a lock that can be opened by a key only the user has access to. The gun lock is a singular component to ensure the design is simple yet effective. Due to our ergonomic design, adults can easily handle the gun lock in important situations while keeping it away from children or unauthorized individuals. Compared to currently existing cable locks and gun safes on the market, our design ensures the trigger itself is securely encased. Working in conjunction with students at our local medical school, we have received feedback on our design from multiple stakeholders, including gun-owning families that have children. Since then we have applied this feedback to refine our design and work towards making it more adjustable to guns of all sizes. Ultimately, our project will allow adults to more safely own and store firearms in households with children.

Mentor(s): Ashley Taylor, Biomedical Engineering and Mechanics, Virginia Tech

Caroline Gerling
Virginia Tech/Wildlife Conservation

Rodenticide Exposure in Non-Target Predator Species: The Least Weasel (Mustela nivalis)

Weasel populations have declined in the past 60 years throughout North America, yet the underlying causes remain unclear. Several anthropogenic factors have been proposed, including widespread use of rodenticide, which may reduce prey availability (e.g., voles and mice) and directly harm predators through secondary exposure. Anticoagulant rodenticides (ARs) are commonly used to control rodent populations in both urban and agricultural environments, and growing evidence reveals the unintended consequences of secondary AR exposure in non-target species, particularly mammalian carnivores. While secondary AR exposure has been documented in several mustelid species in Europe, limited studies have been conducted in North America. The least weasel (Mustela nivalis), the world's smallest carnivore, is an elusive and understudied species in Virginia with limited ecological and toxicological data available. This study aims to assess AR presence in least weasels in Southwest Virginia. Liver tissues were collected from eight least weasel carcasses, salvaged from cat kills, recovered between 2021–2025 across six counties in Southwest Virginia. Samples were analyzed for AR residues using liquid chromatography-tandem mass spectrometry (LC-MS/MS). We hypothesize that measurable concentrations of ARs will be detected, indicating that secondary exposure to ARs poses a potential toxicological risk to least weasels in Southwest Virginia. Our findings will contribute to a broader understanding of AR risks to small carnivores in North America that could inform future management or conservation strategies for weasels.

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

Patrick Gilles
Virginia Tech/Biochemistry

Deciphering Phosphorylation-Induced Changes in α-Synuclein Structure using Drude Polarizable Simulations

Parkinson's disease (PD) is the second-most common neurodegenerative disease globally, affecting about 10 million people worldwide and 1 million in the United States. Although the cause of PD remains unclear, the intrinsically disordered protein (IDP) α-Synuclein exerts cytotoxic effects in PD, specifically when it aggregates into amyloids. As is common among IDPs, α-Synuclein is enriched in polar and charged residues, and is the target of phosphorylation at multiple sites. α-Synuclein present in brains of PD patients has significantly elevated levels of phosphorylation at Ser129, though the implications of this modification with regards to aggregation and cytotoxicity are still poorly understood. We employed molecular dynamics (MD) simulations to study the dynamics of α-Synuclein in the phosphorylated and non-phosphorylated states. Importantly, we used the Drude polarizable force field (FF), as electronic polarization within the protein is likely different as a function of phosphorylation. α-Synuclein contains 140 residues, and as such is the largest amyloidogenic protein ever studied with the Drude FF. Given the challenges with simulating such a complex system, we performed a combined 8 microseconds of unbiased simulations, which we then subjected to various clustering techniques to characterize the phosphorylated and non-phosphorylated conformational ensembles. Additional characterization of the conformational ensemble included secondary structure classification, radius of gyration, solvent accessible surface area, and electronic polarization in backbone and sidechain moieties. This work is the first step in understanding the relationship between induced polarization changes as a function of phosphorylation with the secondary and tertiary structure of α-Synuclein.

Mentor(s): Justin A Lemkul, Virginia Tech

Xavier Gitre

Virginia Tech/General Studies

Partying Parulidae: Interspecific Social Networks of Parulidae Warblers in Active Migratory Passage

Remarkable declines in migratory songbird populations necessitate the investigation of persistent gaps in the study of migration ecology. As songbirds in active migratory passage have proven frustratingly enigmatic, almost no literature has investigated the sociobiology of nocturnal migrants, despite strong evidence from radar and acoustic observations suggesting they interact in flight. Studying these interactions will provide insight into the social structures of nocturnal migrants, how they facilitate information exchange, and, crucially, if social factors influence poorly understood variables linked to population declines (chiefly window collision rates, which correlate with flight calling behavior). Advances in flight call recording have opened an exciting window into the interspecific ecology of species in active migratory passage. Here, I utilize this technology to investigate the sociobiology of an abundant and diverse lineage of nocturnally migrating songbirds, Parulidae warblers, using social network analysis. I test the hypotheses that 1) they interact socially, interactions which are structured by a nonrandom and ecologically relevant social network that resembles an ecological community, 2) variables relevant to nocturnal migration underlie that structure, and 3) migrants' social behavior is associated with their risk of window collisions. I find support for the first and third hypotheses, while the second is partially supported but remains somewhat ambiguous. These results merit further investigation into interactions between migrating songbirds on larger taxonomic and spatiotemporal scales and their implications for window collision rates.

Mentor(s): Katharine Davis, Blacksburg High School

Mayank Goel
Virginia Tech/Computer Science

DBWorkout

SQL proficiency is essential for database management, yet traditional teaching methods often lack interactive elements that reinforce practical skills. This project addresses the question: How can we create an engaging, real-time platform that enhances SQL learning through gamification and immediate feedback?

DBWorkout is a web-based solution designed to transform SQL education by providing instructors with tools to create custom practice sessions and students with an interactive environment to develop database skills. This platform fills a critical gap in database education, where theoretical knowledge often outpaces practical application abilities.

Our approach leverages modern web technologies including WebSockets for real-time feedback, cloud-based databases for practice environments, automated query validation, and OAuth authentication. The system features role-based access for students, instructors, and administrators, allowing instructors to create custom database schemas, design question banks, and monitor student progress through a dynamic leaderboard. Students benefit from immediate feedback on query correctness, timed challenges, and progress tracking across course sessions.

The resulting platform creates a collaborative learning environment that gamifies SQL practice while providing instructors with valuable insights into student performance. Preliminary testing indicates that real-time feedback significantly improves query-writing skills and student engagement. DBWorkout transforms traditional database education by bridging theoretical concepts with practical application through an interactive, competitive framework that prepares students for real-world database management challenges.

Mentor(s): Sehrish Nizamani, Computer Science, Virginia Tech

Julia Gregory
Virginia Tech/Microbiology

Antagonism of Inflammatory Signaling by NLRX1 During SARS-CoV-2 Infection

During the SARS-CoV-2 infection, there is an overactivation of the innate immune response due to uncontrolled production of cytokines otherwise known as the cytokine storm. These unchecked cytokines cause increases of inflammation and damage host tissue leading to a more severe disease progression. Prior studies have shown NLRX1, a PRR involved in innate immunity, is able to modulate NF-kB and interferon signaling during an influenza infection. These pathways are involved in inflammation signaling and regulation of cytokine production, impacting the cytokine storm. Notably, preliminary data shows NLRX1 to be downregulated in patients during a SARS-CoV-2 infection indicating that NLRX1 is involved in modulation of the cytokine storm. We hypothesize that NLRX1 acts to antagonize inflammatory signaling to dampen the immune response and reduce damage to the host during SARS-CoV-2 infection. Using patient derived data, Nlrx1-/- mice, and transduced human airway epithelial cells, we worked to profile NLRX1's role in the cytokine storm. To further understand this phenotype, Calu3 cells transduced to overexpress NLRX1 were challenged with SARS-CoV-2, and decreased expression of proinflammatory cytokines were observed. We also observed a protective nature of NLRX1 against SARS-CoV-2 infection with increases in viral titer and inflammation of airways in Nlrx1-/- mice. However viral titer decreases in NLRX1 overexpressed Calu3 challenged with SARS-CoV-2. Our data indicates that NLRX1 is acting against inflammatory signaling to prevent the cytokine storm and has a protective nature against SARS-CoV-2 infection. Examination of the differentiation of cytokine expression due to NLRX1 could indicate a potential drug target.

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

Nathan Griffin
Virginia Tech/Aerospace Engineering
Andrew McGrellis
Virginia Tech/Aerospace Engineering

Localizing and Identifying Nanosatellites with Machine Learning on Edge Radar in Space

With the commercial sector now routinely deploying clusters of small satellites, quickly distinguishing these satellites represents an increasingly urgent technology gap. This work augments satellite deployers with low-cost radar modules to track and identify nanosatellites in a cluster with machine learning (ML) at the edge. Acting cooperatively with ground facilities, deployers rapidly distinguish satellites shortly after deployment and provide a foundation for future autonomous proximity operations with nanosatellites.
Our completed frequency modulated continuous wave (FMCW) radar dataset experiments demonstrate convolutional neural network (CNN) based processing achieves nearly 3x higher accuracy compared to traditional signal processing techniques. Ongoing work suggests that CNNs process raw range-doppler data faster and more accurately than existing radar data filtering techniques. With these new data analysis techniques, nanosatellite deployers and small satellites provide real-time tracking of closely clustered satellites using ML at the edge.

Mentor(s): Bradley Denby, Aerospace and Ocean Engineering, Virginia Tech

Sophie Gross
Virginia Tech/Biology

Influence of Environmental Nicotine Alkaloids on Phyllobates aurotaenia Toxicity

Note: This project is currently a proposal, and research will begin next semester.

Poison dart frogs sequester toxic alkaloids from their diet and secrete them through their skin for defense against predators. These incredible amphibians produce roughly 800 unique alkaloid compositions. The toxicity of these compositions depends on the nature and concentration of the alkaloids, the location, sex, age, season, and other factors. The reason for this incredible diversity in poison dart frog toxicity is currently unknown. It is also unknown why certain species of poison dart frogs sequester alkaloids such as dihydroquinine (DHQ) and nicotine – these alkaloids are much less toxic and thus likely not necessarily utilized by the frogs for protection. Nicotine is a well-known alkaloid found in the Solanaceae family of plants but is most potent in Nicotiana tabacum and Nicotiana rustica. There is a potential that poison frogs attain nicotine from alkaloid consuming insects or directly from leaf litter in the wild. The combination of toxic and non-toxic alkaloids, like nicotine, could contribute to certain mechanistic processes implicated in poison dart frog metabolism. For example, nicotinic acetylcholine receptors (nAChRs) bind to nicotine and other agonists, as well as batrachotoxin (BTX) and other toxins at the same allosteric site. nAChRs function in neurotransmission, muscle control, ion conductance with voltage gated sodium channels, and biological feedback loops. Because of nicotine's key role in this receptor, there may be a cascade of regulatory effects that correlate with autoresistance or increased toxification. This experiment aims to evaluate the function and uptake process of an environmental alkaloid, nicotine, to determine its influence on poison frog toxicity

Mentor(s): Roberto Marquez, Evolution, Genetics, Virginia Tech

Maureen Habashy
Virginia Tech/Psychology
Ashtyn Grow
Virginia Tech/Psychology

Determinants of Romantic Relationship Satisfaction: The Role of Gratitude Expression and Parental Modeling

This study investigated the interplay between gratitude expression and parental modeling in shaping romantic relationship satisfaction, offering insight into relational well-being. Specifically, it explored how gratitude expression modeled in participants' primary caregivers' romantic relationships influenced individuals' own expressions of gratitude in their partnerships. Additionally, the study examined demographic and contextual variables that may influence gratitude expression and perception, such as relationship length and type. A sample of 160 to 200 participants completed a survey that included the Couples Satisfaction Index (CSI), the Appreciation in Relationships Scale (APS), and a modified version of the APS assessing perceived caregiver gratitude expression. Results revealed a strong positive correlation between individuals' expressions of gratitude and their relationship satisfaction, supporting the main hypothesis. Participants who reported greater exposure to caregiver gratitude expression also tended to express more gratitude in their own romantic relationships, suggesting a positive intergenerational association. Although statistically significant, correlations between gratitude expression and contextual factors like relationship length and type were weak, indicating these variables may play a lesser role. By integrating intergenerational modeling and relational context, this study contributes valuable insights into the mechanisms through which gratitude supports romantic relationship satisfaction. Findings underscore the importance of caregiver modeling in shaping emotional expression and highlight the need for further exploration into how gratitude functions across diverse relational dynamics and populations. Understanding what drives higher or lower levels of gratitude expression is a critical next step, as it can inform the development of targeted interventions to enhance relational well-being.

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

Chloe Hair
Virginia Tech/Biochemistry
Scarlett Flores
Virginia Tech/Biochemistry
Jacqueline Frank
Virginia Tech/Biochemistry
Juhi Vaidya
Virginia Tech/Biochemistry

Mu-Opioid Pain Receptors: How An Amino Acid Mutation Impacts Affinity

Opioid overdose deaths have rapidly increased over the past 25 years, indicating a need for continued research into how opioids interact with receptors in the body. This experiment is important due to the implications of Mu-Opioid receptor (MOR) function in pain relief and addiction. If specific mutations can enable MOR to produce the same therapeutic effect with smaller opioid doses, it may be possible to lower prescribed dosages, particularly benefiting patients with opioid addiction. This study examined whether mutating a hydrophobic residue to a hydrophilic one would alter ligand binding affinity. The wild-type MOR and its ligand were analyzed using molecular docking to establish a baseline affinity. A site-directed mutation was introduced at residue 151, replacing methionine with glutamate, and the mutant protein was docked with the same ligand. Results showed that the wild-type receptor had a more favorable predicted binding energy than the mutant, suggesting stronger ligand affinity in the unmutated form. These findings indicate that introducing a hydrophilic residue at this site reduced the receptor's ability to interact effectively with the ligand, disproving the hypothesis. This experiment suggests that the native, hydrophobic version of the Mu-Opioid receptor may allow opioids to exert their effects at lower doses, which could inform future strategies for reducing opioid use while maintaining therapeutic outcomes.

Mentor(s): Anne Brown, Research and Informatics, Virginia Tech

Ghaleeb Hakim

Virginia Tech/Mechanical Engineering

The Three-Tab Keyguard: A Novel, Low-Cost Device to Help Special Needs Students Communicate

Autism affects approximately 1 in 36 children in the U.S., with 30% considered “minimally verbal.” Many of these young students often rely on aids such as text-to-speech apps for communication, but motor control impairments such as dyspraxia or cerebral palsy can make this challenging. Approximately 7% of U.S. children in special education are classified as having multiple disabilities, highlighting a need for accessible solutions in communication.

This project aims to address this challenge by developing low-cost tactile aid devices for iPad text-to-speech apps to assist special needs students with communication. These devices, known as iPad keyguards, are physical plates with holes used to guide users’ fingers to the correct text-to-speech buttons. They typically cost $25 - $100 and rely on attachment mechanisms such as velcro, suction cups, and magnets.

Using a design-based research approach, our transdisciplinary undergraduate research team developed and tested five prototypes through CAD, laser cutting, and 3D printing. Our final novel “three-tab keyguard” design features strategically placed tabs that leverage the iPad’s existing physical structure - including the headphone jack, power button, and charger port slots - for secure attachment, eliminating the need for external adhesives and magnetic attachments. By utilizing this simple approach, we reduced the cost by over 85% from the industry standard - down to only $3.30 per unit - making the device far more affordable for schools and families.

Our three-tab keyguards are currently being tested in Virginia elementary schools, where they are already demonstrating their ability to empower students with disabilities to communicate more effectively. Feedback from these trials will guide adaptations for broader iPad case compatibility, ensuring the device can meet diverse user needs across different educational settings. By reducing costs and enhancing accessibility, our project not only supports inclusivity in classrooms, but also paves the way for future innovations that can positively impact the lives of students with disabilities nationwide.

Mentor(s): Ashley Taylor, Department of Biomedical Engineering, Virginia Tech

Sarah Hammond
Virginia Tech/Psychology
Caroline Hopkins
Virginia Tech/Psychology
Samantha Seibert
Virginia Tech/Psychology
Tanisha Kiran
Virginia Tech/Clinical Neuroscience

Gesture and Learning in Young Children

Gesturing, a form of non-verbal communication, plays a crucial role in how older children learn new math concepts (Church & Goldin-Meadow, 1986) but less is known about the role of gestures for preschool learning. Studies show that gestures – especially gestures that add new information to speech (mismatch), may signal a transitional phase of understanding and readiness to learn; thus, making children more receptive to instruction. We explored this idea by teaching preschoolers (ages 3-5) one type of conservation reasoning through words and gestures.

To test our hypothesis, we utilized Piagetian conservation tasks to examine how children understand quantity invariance- the concept that an amount remains unchanged despite alterations to its physical appearance. Based on their responses, children were categorized into three groups: conservers (demonstrating full understanding), partial conservers (showing inconsistencies in understanding), and non-conservers (lacking understanding). Over several weeks, trained undergraduates systematically coded children's gestures and verbal responses to assess cognitive alignment. After the baseline data was obtained, a target learning intervention was introduced to children to measure their progress with conservation through a post-test evaluation.

We expect results to reflect that gestures were able to express a child's understanding of conservation even when they verbally could not express it. Children who use gestures, even in the absence of clear verbal explanations, will exhibit a deeper conceptual understanding and greater improvement in learning outcomes compared to those who did not gesture. Incorporating non-verbal communication into educational approaches may enhance children's ability to grasp complex concepts.

Mentor(s): Isabel Bradburn, Human Development, Virginia Tech
Mahmut S Gurdal, Human Development, Virginia Tech

Caleigh Hampton
Virginia Tech/Human Development

Capturing the Sound of SWVA: Investigating Rates of /ay/ Monophthongization Usage

Appalachia is a unique region that has been considered linguistically distinct from both Mainstream US English and Southern American English (SAE) (Wolfram & Christian, 1976). One feature that appears to be shared between SAE and Appalachian English (AE) is /ay/ monophthongization, which is when the diphthong /ay/ loses its offglide (this may make a word like 'ride' sound like 'rahd'). However, previous work has shown that within broader SAE, /ay/ monophthongization only occurs in pre-voiced consonant (e.g., 'ride') and open-syllable contexts (e.g., 'rye'), while in AE it can occur across all environments, critically including pre-voiceless consonants (e.g., 'right') (Reed, 2016). In my work I've been looking at whether this pattern of following environment holds in Southwest Virginia (SWVA), a linguistically understudied part of Appalachia. In a pilot study using an existing corpus of recordings from 14 SWVA speakers (7M:7F), I found that while men displayed expected patterns, with monophthongization relatively stable in all environments (~77%), women changed rates depending on the following environment. However, unlike the common SAE pattern where the difference is based on voiced/open-vs.-voiceless following consonants, the SWVA women's /ay/ pronunciation was impacted by whether the vowel was in an open or closed syllable (76% and ~61% respectively). These findings provide foundation for my current project, where I am currently collecting speech from older (>50) SWVA speakers (current N=16) completing a short wordlist, word-guessing game, and interview. Final results are expected to show how small differences in pronunciation reveal sub-regional language variation.

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

Lauren Handley
Virginia Tech/Water: Resources, Policy, and Management
Kora Bednar
Virginia Tech/Water: Resources, Policy, and Management

Tsunami Genesis, Risk Reduction, Early Warning Systems, and Evacuation

Tsunamis, though relatively rare, are massive geophysical hazards capable of devastating coastal and small island communities around the globe. This was made evident by the 2004 Indian Ocean and 2011 Great East Japan tsunamis, among others. This study, solicited by The Routledge Handbook of Disaster Mitigation & Preparedness, serves as a reference not only for researchers but also policymakers, practitioners, voluntary organizations, and international and bilateral agencies engaged in disaster management. Specifically, this study details: how tsunamis originate; tsunami risk and risk reduction; national and regional early warning systems; and evacuation methods. Areas adjacent to active tectonic plate boundaries, the Pacific Ring of Fire in particular, are high-risk environments. Meanwhile, populations themselves exhibit vulnerability based on variables such as infrastructure, governance, demographics, and socioeconomics. Prior to tsunami events, societies can mitigate by introducing protective infrastructure, embracing nature-based solutions, and public awareness measures. Sensors such as tide gauges, buoys, off-shore bottom pressure gauges, and remote high-frequency ocean radar can be utilized to quickly detect tsunamis. Next, warning systems must be in place along with efficient dissemination via multiple modes of communication (e.g., sirens, television, mobile phones). Finally, evacuation procedures should be deployed. Factors like foot and vehicle traffic, horizontal versus vertical evacuation, and establishing evacuation sites must be considered—all of which can be informed by drills and computer modeling. Collectively, these approaches help to mitigate human and economic losses.

Mentor(s): Luke Juran, Geography, Virginia Tech

Lilly Harris
Virginia Tech/Animal and Poultry Science

Correlation between Grain-Free Diets and Dilated Cardiomyopathy in Companion Dogs

The growing popularity of grain-free diets for dogs has raised concerns about potential health risks, particularly their association with dilated cardiomyopathy (DCM), a condition that can lead to congestive heart failure. This study evaluates whether dogs consuming a grain-free diet exhibit a higher incidence of DCM compared to those on grain inclusive diets and examines additional health effects. To investigate this, we conducted a comprehensive literature review, analyzing studies on grain-free diets across various dog breeds and pulse ingredients. Each study was systematically annotated to identify trends in dietary impact on dog health. While some studies suggest a potential association between grain-free diets and the development of DCM, variations exist across breeds and study designs. The anticipated results from our in-progress analyses highlight the need for further investigation into the role of pulse ingredients like peas and other nutritional factors in dog cardiac and overall health. Additionally, access to echocardiogram data from dogs enrolled in the Dog Aging Project presents an opportunity for future research to directly compare cardiac outcomes between diet groups. Understanding these relationships and their long-term impacts is crucial for guiding pet nutrition recommendations and ensuring dog well-being.

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

Zachary Harris
Virginia Tech/Biochemistry
Annette Do
Virginia Tech/Biochemistry
Malaika Amir
Virginia Tech/Biochemistry
Amira Stufflebeem
Virginia Tech/Biochemistry

Mutation of Lys-233 to Asp-233 in the Mu Opioid Receptor and it's Effects on Ligand Binding

Analgesic drugs like morphine, ketamine, and other opioids all bind to the mu-opioid receptor protein (MOR), the primary target for these drugs that plays a crucial role in pain perception, reward pathways, and addiction. The receptor is responsible for ligand binding of these drugs to generate a cell signaling pathway with the result being the activation of G proteins. The ligand binding is essential to ensure that the protein can send a signal to the cell. This generates the question; what change, if any, will occur if there is a charge difference within the ligand receptor. To investigate this charge difference the Lys-233 residue, a positively charged amino acid, was mutated to Asp (aspartic acid or aspartate), a negatively charged amino acid. This change will generate a negative effect on the ligand binding affinity by changing overall electrostatic interactions. To properly investigate the change, structural modifications were conducted using molecular visualization, where Lys-233 was mutated to Asp-233 in a single step using the mutagenesis feature. Using molecular docking the mutated MOR had a morphine antagonist redocked. The binding affinities were compared to that of an unmodified MOR. The change in charge due to substituting the amino acid improved the binding affinity. The mutated protein revealed an affinity of -9.1 kcal/mol while the original protein had a binding affinity of -8.1 kcal/mol, showing that the mutation from Lys-233 to Asp-233 improved the binding affinity of the MOR for the morphine antagonist, creating a stronger, more stable interaction between the receptor and its ligand, making it easier for drugs to bind to the site.

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

Leona Hedden
Virginia Tech/Chemistry
Pheobe Zhou
Virginia Tech/Exercise and Health Science
Benjamin Hiatt
Virginia Tech/Biology
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Virginia Tech/Chemistry

Effectively Composting with Various Substrates

The goal of the research project is to measure how the substrate used in the compost affects its nutrient and moisture content, thus affecting the optimal conditions for quick composting. With our methods, the composting process is cheaper and more accessible to set up, but still effective in composting food waste. Thus, allowing for colleges with possibly less funding to still set up composting systems for their large amounts of food waste. Most research pertaining to cheaper large-scale composting has been done on farm areas, thus, we are trying to expand the knowledge in composting for college campuses to promote a more sustainable future. To collect data for our experiment, four bins were created, with a control bin containing base materials of soil and coffee grounds, with wheat straw on top. The decomposer used for each bin was a liquid culture of mushrooms. Bin 1 was the control, bin 2 had leaves, bin 3 had coco coir, and bin 4 had both leaves and coco coir. The bins were checked each week on Friday for six weeks, with the moisture content, compost appearance, and food added being recorded. During this the bins also had moisture added if deficient and were aerated. The pH, nitrogen, potassium, and phosphorous levels were also checked near the beginning and the end of the 6 weeks. The food added typically decomposed within 2-3 weeks. The results will show either a stark contrast between various nutrient values depending on substrates utilized, or no difference throughout the span of the six-week experiment.

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

Lyann Hernandez
Virginia Tech/Clinical Neuroscience

Mild traumatic brain injury preferentially affects dopaminergic neurons and no other neurons in the striatum of mice

It's known that traumatic brain injury (TBI) is a significant risk factor for the development of Parkinson's disease (PD), the mechanisms that drive this correlation are yet fully understood. PD, a progressive, neurodegenerative disorder, is defined by the accumulation of alpha-synuclein protein in dopaminergic (DA) neurons, leading to the gradual death of these cells in the substantia nigra (SN) region of the brain. Neuroinflammation, characterized by the activation and infiltration of immune cells in the brain, is a significant characteristic of both TBI and PD, but it is unknown how much TBI directly effects the progression of PD through various neuroinflammatory pathways, especially at chronic time points post-injury. To study this, we used a rodent model of TBI in addition to the alpha synuclein pre-formed fibril (PFF) model of PD. Our findings showed a significant loss of DA neurons in the SN, with associated deficits in the striatum, 90 days post-injury in mice that received TBI. When mice received TBI prior to the seeding of PFFs, similar DA cell death was observed, in addition to alterations in alpha-synuclein propagation when compared to experimental controls. To determine whether DA neurons were specifically susceptible to their observed degeneration, or if other neuronal populations in those brain regions were negatively impacted as well, quantification of Nissl+ cells in the striatum was performed and found to be unchanged. These findings indicate the specificity of DA neurodegeneration within our model. Future directions of this study will evaluate the potential role of the adaptive immune response in mediating these observed PD-associated pathologies.

Mentor(s): Alicia Pickrell, School of Neuroscience, Virginia Tech

Ainsley Hetherington
Virginia Tech/Cognitive and Behavioral Neuroscience

Childhood Adversity as a Predictor of Risk-Taking Behavior

Adolescence is characterized by high rates of risk-taking behavior (e.g., drug use, lying, rule-breaking). Childhood adversity (e.g., abuse, exposure to violence) is associated with increased risk-taking behavior based on prior studies with older adolescents and young adults retrospectively reporting on their early childhood trauma. Research examining sex differences have found higher rates of risk-taking behaviors in males, but also suggest that this sex difference becomes minimal as the adversity faced increases. Given this backdrop, the current study sought to explore the rates of childhood trauma and risk-taking behaviors in a sample of 68 youth ages 8-15 years (60.3% female; 91% White; family income=$28,000-$700,000). Additionally, it examined the role of childhood adversity in risk-taking behaviors, and whether this association differed by sex assigned at birth. Childhood adversity was assessed using child-report on the Child and Adolescent Trauma Screen; risk-taking behaviors were assessed using parent-report on the Behavior Assessment System for Children, Third Edition. Only 16% of the sample endorsed no childhood adversity, with another 54% endorsing only one or two adversities (e.g., stressful or scary medical procedure; car/bike crash). With regard to risk taking behaviors, the majority of the sample endorsed lying (85%), disobeying (79%), and breaking rules (76%), whereas only 54% endorsed using tobacco/nicotine, 39% endorsed sneaking around, 22% endorsed stealing, and 2% reported using illegal drugs. Males reported significantly higher risk-taking behaviors; additionally, childhood adversity was related to risk-taking behaviors for males but not females. Results support interventions for males who experience significant childhood adversity to reduce risk-taking behaviors.

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

Sydney Hill
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Virginia Tech/Psychology
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Virginia Tech/Cognitive and Behavioral Neuroscience

Choreography creation is associated with increased dispositional flow and changes in beta neural activity in experienced dancers

Flow, a psychological state marked by task immersion and engagement, is often experienced by dancers during performance. While flow is well-documented subjectively, its physiological correlates in the brain remain less understood. Exploring how brain activity in dancers corresponds with flow state during choreography development, we recruited six female dancers (ages 19–22) to co-created short solo performance pieces over two months. Electroencephalography (EEG) data were collected at rehearsal start, mid-way through choreographic process, and at final performance. A 32-channel EEG system (LiveAmp 32, Brain Products GmbH, Gilching, Germany) recorded brain activity during baseline rest, choreography planning, rehearsal, and performance. To evaluate psychological changes, participants completed behavioral questionnaires before and after each rehearsal/performance (acute effects) and the semester (longitudinal effects). Acutely, mindfulness of the body increased ($p=0.0355$; $r =$). Longitudinally, dance increased dispositional flow ($p=0.0313$; $r = 0.899$) and positive affect ($p = 0.0263$; $r = 0.953$). An increase in beta-band activity (12–30 Hz) was observed during solo performance (rehearsal, $p<0.05$, paired permutation t-test). Additionally, during pre-performance resting brain state, alpha-band (8–12 Hz) activity peaked at 10 Hz before first and second rehearsals, whereas a lower peak frequency (8 Hz) emerged before the final performance. This shift may reflect a change from a focused state to a more relaxed state immediately preceding performance. Collectively, findings suggest flow and other positive affective states may be linked to alterations in brain state during dance, specifically heightened beta activity associated with intense focus and mental engagement during performance.

Mentor(s): Julia Basso, Human Nutrition, Foods, and Exercise, Virginia Tech

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Virginia Tech/Computer Science

Usability Heuristics and Large Language Models: Enhancing University Website Evaluations

Usability evaluations typically rely on expert reviewers, who can be difficult to find and expensive to employ. In this study, we explore how large language models (LLMs) assisted in the usability evaluation of 10 university websites using Nielsen's 10 usability heuristics: visibility of system status, match between system and real world, user control and freedom, consistency and standards, error prevention, recognition rather than recall, flexibility and efficiency of use, aesthetic and minimalist design, help users recognize and recover from errors, and help and documentation.

By leveraging LLM-driven methodologies, this study evaluates how effectively LLMs can identify usability issues in university websites. Each website was analyzed using two different LLMs, and only the usability issues identified by both models were selected for further validation.

Findings highlight that LLMs can assist human evaluators by identifying additional usability issues that might be overlooked in manual assessments. However, the results also revealed that LLMs occasionally hallucinate usability issues, making human verification essential. The validation process showed that while LLM-generated assessments often aligned with expert insights, human reviewers were necessary to confirm the accuracy and relevance of the identified issues. This underscores the role of LLMs as a supportive tool rather than a standalone replacement for expert evaluations.

Future work includes comparing LLM-generated usability evaluations with expert human evaluations to assess their relative effectiveness and reliability. Additionally, we aim to refine LLM evaluation processes, integrate multimodal data—such as user action logs and screenshots—to enhance their usability assessment capabilities further, and develop systematic methods for filtering hallucinated issues.

Mentor(s): Sehrish Basir Nizamani, Computer Science, Virginia Tech

Lucas Holland
Virginia Tech/General Studies

The Relationship Between Heat and Income in Virginia: A Correlational Study

Heat is the leading weather-related cause of death in the United States, with its impacts exacerbated by climate change and socioeconomic disparities. This study examines the relationship between heat-related illness rates (HRI) and socioeconomic and environmental factors in Virginia from 2017–2021, aiming to identify vulnerable populations and inform mitigation strategies. Data from the Virginia Department of Health, U.S. Census databases, and prior studies were analyzed at the county level using Bayesian statistical inference and modeling, Ordinary Least Squares (OLS), and Generalized Linear Models (GLMs). Despite employing multiple regression models, log transformations, and outlier adjustments, findings revealed consistently weak or negligible correlations. Comparison with existing research highlighted the limitations of county-level analyses, as significant relationships between environmental factors and heat disparities observed at finer scales, such as census block groups (CBGs), were obscured in aggregated county-level data. Challenges included the difference in geographical grouping of HRI data and hospitalization cases, and the lack of publicly available granular data due to privacy concerns, limiting the ability to capture nuanced relationships. These findings underscore the importance of high-resolution data and more fine-tuned spatial analysis in addressing heat-related health disparities. Future research should prioritize finer-scale analyses, incorporate additional variables such as occupational exposure and urban planning, and advocate for improved public access to granular health and environmental data to support equitable climate adaptation strategies.

Mentor(s): Karin Warren (Environmental Studies), Virginia Tech
Sherry Pugh, Southwest Virginia Governor's School (SWVGS)
Katherine Davis, Blacksburg High School

Jack Horton
Virginia Tech/Biochemistry

Questioning the Canonical Mechanisms of Cardiac Automaticity

Throughout the body there are a multitude of systems which rely on synchronized spontaneous automaticity. When defects occur within these systems, diseases arise such as epilepsy, premature labor, or bradycardia. Looking at the heart specifically, bradycardia results from defects in the two canonical clocks of cardiomyocytes – the calcium clock and the membrane clock. Curiously, experimentation shows that upon inhibition of these two canonical clocks, automaticity in cardiomyocytes persists. Additionally, models suggest that gap junctional coupling synchronizes canonical clocks in tissue, but experimental evidence displays conflicting results. This project aims to confirm that automaticity is present in cardiomyocytes without functioning canonical clocks and that synchronization between neighboring cardiac tissue continues despite disruption of gap junction proteins. Atrial tissue was collected from Gallus gallus embryonic cells, digested, incubated until confluency, and imaged with a calcium indicator to analyze the presence of automaticity in the cells. The cells were then exposed to canonical clock inhibitors and gap junction uncouplers to prove the presence automaticity in the absence of the canonical clocks and gap junctions. Our evidence shows that multicellular networks are resistant to quiescence when inhibiting the canonical clocks and that disrupting gap junctions results in persistent synchronization, suggesting the presence of a third clock responsible for automaticity in cardiomyocytes.

Mentor(s): Greg Hoeker, FBRI - TBMH, Virginia Tech
Alec Beck, FBRI - TBMH, Poelzing Lab, Virginia Tech
Steven Poelzing, FBRI - TBMH, Virginia Tech

Jonah Hutchison
Virginia Tech/Forestry

Usage of High Elevation Red Spruce Patches by Northern Saw-whet Owls in Virginia

Northern Saw-whet owls (Aegolius acadicus) primarily occupy forests in southern Canada and the northern United States. Some saw-whet owls migrate south in the fall, occasionally wintering throughout Virginia and infrequently breeding in the Appalachian Mountains of Virginia. In the Southern Appalachians, saw-whet owls generally breed in high elevation mixed forest cover. A few observations of saw-whet owls have been recorded near Mountain Lake by eBird users, indicating that they may breed there. In Virginia, breeding habitat of these owls is not well-studied. High elevation spruce and hemlock bogs present near Mountain Lake may provide quality breeding habitat for these birds, being similar to the breeding habitat in other parts of their range such as Maryland. However, in other areas, like the Appalachian Mountains in Tennessee, saw-whet owls appear to prefer deciduous cover. Ten autonomous recording units were placed in and outside of five red spruce patches near Mountain Lake to determine the presence or absence of saw-whet owls. The audio data will be processed using birdNET, and if saw-whet owls are detected, their preferences for forest cover types will be evaluated using data from tree and shrub sampling. Not all of the data has been collected yet, but the March and April data will likely have detections since these months are when the advertising call is most common. This research will help to fill an information gap about this species habitat selection in Virginia.

Mentor(s): Corey Green, Forest Resources and Environmental Conservation, Virginia Tech
Elizabeth Hunter, CNRE: Fish and Wildlife Conservation, Virginia Tech

Rana Ibrahim
Virginia Tech/Psychology

From Play to Structure: Does the Transition from Kindergarten to First Grade Influence Children's Inhibitory Control and Social Skills?

The transition from kindergarten to first grade is an important part of early childhood development. During this time, children face new academic and social expectations that can affect how well they manage their behavior and how they interact with others. This study explores how this transition may influence inhibitory control and social competence. Specifically, it asks whether the move to a more structured classroom environment in first grade impacts children's ability to regulate their actions and get along with others. To explore this, we will use two methods: a "Simon Says" task to observe children's self-control, and a social competence questionnaire completed by parents to assess their children's social skills. Data will be collected over a year and a half, starting in the middle of kindergarten, and continuing through first grade, with three assessment points throughout the study. We expect that as children adjust to first grade, they will show growth in inhibitory control with fewer mistakes during the Simon Says task and higher ratings of social competence from their parents as time goes on. Understanding how early school experiences affects children's inhibitory control and social competence can help parents, teachers, and schools better support children during this important transition and may also offer helpful strategies for supporting children with ADHD and other mental health conditions, and for preparing kindergartners for the new expectations of first grade.

Mentor(s): Nikki Lewis (Honors College - Faculty Fellow, F.I.R.E. Starters Program), Fire STARTERS Research Program Faculty Fellows, I have been a participant of the program since the start of the fall semester.
Anne M Brown, Virginia Tech
Liesel Ashley Ritchie, Virginia Tech
Paroma Subodh Wagle, Virginia Tech.

Athreya Iyer
Virginia Tech/Biomedical Engineering

Computationally Determined Thermal Limits for Common Histotripsy Treatments

Histotripsy is an emerging clinical modality for non-invasive mechanical ablation in soft tissue, yet its thermal effects which may cause collateral tissue injury have not been extensively investigated . This study simulated heating from different histotripsy exposures to evaluate thermal effects in silico.
An acoustic modeling toolbox (k-Wave) was used to create an axisymmetric linear propagation simulation through layered soft tissues. Pulsed histotripsy exposures were simulated for different transducer geometry, focal pressures , frequencies, and pulsing schemes , passing through the tissue layers with up to 24 seconds exposure simulating single-point treatments. A 3D bioheat transfer simulation was used to calculate thermal dose and focal temperatures.
Frequency, duty cycle, and focal pressure strongly affected heating rate. No simulations at 0.01% duty cycle produced thermally ablative thermal dose (>240 minutes), while many at 1% duty cycle were thermally ablative within 24 seconds (Figure). For example, a transducer f-number of 0.8, focal pressure of 20 MPa, 1 MHz frequency and 1% duty cycle produces a temperature rise of 25 Celsius and thermal dose of 164 minutes after 10 seconds. Spatial-peak temperature rises ranged from 0.0254 - >100 Celsius after 10 seconds.
This study delineates the thermal limits of histotripsy under relevant exposures. Simulations underline the importance of frequency, duty cycle, and focal pressure in determining whether a treatment can produce significant heating and thermal effects. Ongoing efforts focus on volumetric (scanned) treatments.
The authors would like to thank our funding sources including the NIH (R01CA289288) and the Virginia Tech College of Engineering.

Mentor(s): Adam Maxwell, Biomedical Engineering and Mechanics, Virginia Tech
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Laura Jaber
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Espen Lunden
Virginia Tech/Mathematics
Aditi Shukla
Virginia Tech/Secure Computing

Learning RF Through Gamification

Through the virtual reality Spectral Warrior concept, sponsored through a Naval Engineering Education Consortium (NEEC) grant through the Naval Surface Warfare Center (NSWC) Dahlgren, we aim to provide a thorough and detailed learning experience of radio frequency concepts, which many people tend to not know much about. Using virtual reality as a means to do so allows for unique visualization opportunities with wireless communications, which has an inherent lack of visual elements.

In our current level of the grander "RF Escape Room," the player will learn antenna propagation and beamforming concepts and apply what they've learned to jam enemy missiles and protect the integrity of their ship.

Through the gamification of radio frequency ideas, we hope to offer a realistic and immersive educational resource for students and workforce training to our sponsor, NSWC Dahlgren.

Mentor(s): William Headley, Virginia Tech National Security Institute, Virginia Tech
Elliott Rheault, VTNSI, Virginia Tech
Dr. Brad Davis, both VTNSI, Virginia Tech

Vedanshi Jain
Virginia Tech/Architecture

Role of Literature in Architecture

This project looks at how storytelling in literature can inspire how architects design spaces. The main question is: How can architects use stories, like those in books, to create buildings that make people feel something?

This study draws on literary works by Italo Calvino, Jorge Luis Borges, and Gaston Bachelard, alongside architectural case studies like Frank Lloyd Wright's Fallingwater and the Seamen's Bethel Chapel referenced in Moby-Dick.

I also ran a survey with architecture students at Virginia Tech to see if they've come across this idea in their studies. Many already use narrative elements in design, even if they don't realize it. Through case studies like Fallingwater and the Whaleman's Chapel, I show how stories can shape real spaces.

In the end, this project suggests that fiction and poetry can make architecture more emotional, meaningful, and memorable, and maybe it's time we include more of that in design education.

Mentor(s): Laura Fehr, English, Virginia Tech

Rhone Jenkins
Virginia Tech/Nanomedicine

Modular Polymers as a platform to study Structure Property Relations in Metal Binding

This study investigates the impact of structural modifications in modular copolymers on their intrinsic properties, specifically by using post-polymerization modification of Poly(tetrafluorophenyl acrylate) (PTFPA), with a focus on applications in rare-earth element (REE) chelation. REEs are used in a variety of technologies, but their purification and separation are often challenging and environmentally damaging. Due to their low cost and high tunability, polymer chelators are an attractive choice to improve these separations; however, fundamental structure-property relationships have yet to be established. Here, we seek to develop a synthetic method to understand how changes in the molecular structure influence functional performance, without any batch-to-batch variations. To achieve this, we use a modular approach modify the same batch of PTFPA with differing functionality, while, crucially keeping all other polymer parameters constant. This yields homopolymers—or copolymer, if sub-stoichiometric amounts are added—with systematically varied local structure but the exact same global structure. Towards REE binding, we employed isothermal titration calorimetry (ITC) to evaluate the binding interactions between amino-acid modified PTFPA polymers and REE ions, providing detailed thermodynamic data, including entropy (ΔS) and enthalpy (ΔH) values. These results will provide insights into how structural modifications affect polymer performance in REE chelation. This study advances the understanding of how polymer structure influences functional properties, contributing to the broader field of polymer science and offering potential for enhanced material design in various applications.

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

Matieya Johnson
Virginia Tech/Human Nutrition, Food, and Exercise

Elucidating the role of Collembola and soil microbial communities in beet growth and development

Collembola, tiny soil fauna, play a critical role in soil ecosystems through their interactions with microbes, organic matter, and plant roots. Collembola regulate soil microbial communities by altering their composition and activity through grazing on fungi and bacteria. The interactions between Collembola and microbial communities increase plant available nutrients, which in turn increases plant quality. This study explores the relationship between microbial communities and Collembola (Isotomiella minor) abundance, and their effects on beet growth and development.

This greenhouse study used a randomized factorial design with two soil microbiome treatments (native microbial community and a pathogen-dense microbial community) and three levels of I. minor abundance (none, low, high). Each treatment combination was replicated five times (n=30). Potting media was prepared with the soil microbiome treatments and placed in each pot. Beet seeds were planted, then I. minor were counted and added to the appropriate pots. Plants were monitored weekly for growth stage development and health. At harvest, above and below ground biomass were measured.

It is anticipated that greater I. minor abundance will increase beet growth. Additionally, we predict that I. minor presence will decrease any negative effects on the beets caused by the pathogen-dense microbial community. This research can contribute to ecologically based strategies to improve crop qualities through soil health management.

Mentor(s): Ashley Jernigan, School of Plant and Environmental Sciences, Virginia Tech

Anya Kanodia
Virginia Tech/Aerospace Engineering
Deeya MacKinnon
Virginia Tech/Construction Engineering and Management

Panel Optimization

This project focuses on reducing material waste in the construction industry by developing a machine learning algorithm for optimizing cut-out waste from Structural Insulated Panels (SIPs). The construction industry generates significant amounts of material waste and carbon emissions, driving the need for sustainable practices.The primary goal is to produce cut plans that minimize leftover material, while also exploring opportunities within the circular economy by repurposing offcuts for use by other companies.
To ground our research in real-world application, we partnered with ACME, a SIP manufacturing company. We visited their factory to observe their current production process, gather relevant data, and identify opportunities for improvement. The data collected on panel dimensions, cutting constraints, and existing waste volumes served as the foundation for building and refining our optimization model.
The algorithm will generate cut plans that reduce waste while considering secondary uses for offcuts. In cases where cuts cannot be reused within the primary project, the system checks for potential matches with feedstock needs from other companies, creating a framework for resale and material exchange. This not only reduces landfill contributions, but also provides ACME with a new revenue stream by selling usable waste materials to other firms.
We expect results to show a significant increase in raw material utilization through improved cut efficiency and increased diversion of panel waste for local reuse in the circular economy. This project aims to improve efficiency, reduce environmental impact, and create economic value for manufacturers by aligning smart manufacturing with sustainable business practices.

Mentor(s): Annie Pearce, Building Construction, Virginia Tech

Aditya Kapoor

Virginia Tech/Clinical Neuroscience

Evaluation of Low Intensity Focused Ultrasound to the Dorsal Anterior Cingulate Cortex for Effects on Pain Intensity and Unpleasantness

Chronic pain is a major public health challenge, driving high economic costs and reduced quality of life. The dorsal anterior cingulate cortex (dACC), is crucial for pain perception and autonomic regulation making it a promising target for pain modulation. However, its deep location precludes access with common noninvasive techniques such as transcranial magnetic stimulation (TMS). Low intensity focused ultrasound (LIFU) offers a novel, noninvasive approach using acoustic energy to alter neural activity with high spatial resolution and deep focal lengths.

N = 5 healthy volunteers completed a cold pressor task during continuous electroencephalography (EEG), electrocardiography (ECG), electrodermal (EDR), and respiratory rate (RR) measurements. Following a brief anticipation period, participants immersed their right foot in ice water (2oC) for one minute, rating their pain on a 0–10 numerical scale (0 = no pain, 10 = worst pain imaginable) at 10-second intervals. Emotional discomfort was measured at baseline, immediately after foot removal (60 seconds), and at 2 minutes post-removal using the Wong-Baker scale. The task was performed twice before and twice after either LIFU or sham administration.

The LIFU condition showed a greater reduction in pain ratings than sham at time points 20–40 seconds, with mean differences of -0.8 ± 0.2 to -0.9 ± 0.4 points relative to sham. LIFU did not affect peak pain at 60 seconds. At foot immersion, the ACC condition showed a larger initial increase in emotional discomfort than sham (0.4 ± 0.1 vs. 0.1 ± 0.1). By 60 s, ACC returned to baseline (0.0 ± 0.16) while sham remained elevated (0.5 ± 0.5), and at 120 s, ACC stayed at baseline versus sham (0.2 ± 0.34).

Preliminary findings suggest that a single-session LIFU intervention targeting the dACC modestly reduced both pain and emotional discomfort compared to sham. These results support the feasibility and tolerability of dACC LIFU, indicating promise as a therapeutic intervention. However, longer treatment durations and fully powered studies are needed to confirm its efficacy in reducing pain intensity and unpleasantness.

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Hands to Plants: An Investigation of the Effect of Human Touch on the Lettuce Leaf Microbiome

Growing edible plants in public spaces, particularly school and university classrooms, could help reduce carbon dioxide emissions from buildings and combat food insecurity. 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. To start investigating these plant and human health risks, we used a classroom at Virginia Tech where we grew plants hydroponically with different level of human interaction: one set of plants was kept away from students, students were encouraged to approach a second set without touching plants, and a third set of plants was touched by students. A fourth set of plants was grown in a separate room. Plant leaf-associated bacterial communities were analyzed by 16S rRNA sequencing over a period of 3 months. The plant microbiomes were expected to be minimally affected by humans in the absence of direct contact, intermediately affected by air droplets, and strongly affected by touch. However, we found no consistent differences in taxonomic composition between plants exposed at different levels to people. Also, alpha diversity values were similar and not a single operational taxonomic unit was enriched in any set of plants. While these preliminary results suggest minimal risk of transmission of human-associated bacteria to plants, more controlled experiments are planned to confirm this conclusion and to investigate additional aspects of plant and human health when growing plants in public spaces.

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Optimizing the Acoustic Coupling Material to Enhance Focused Ultrasound Diagnosis of Tuberculosis

Mycobacterium tuberculosis is a gram-positive bacterium which can make traditional methods of DNA extraction and isolation difficult. Focused ultrasound extraction (FUSE) uses high-pressure acoustic pulses generated by a transducer to create a cavitation “bubble cloud” within the target tissue. These cavitation bubbles place stress on the target tissue, causing cells to lyse and release DNA. In this project, the team is focusing on the coupling medium, the material situated between the transducer and the cell sample that propagates the ultrasound waves.
Originally, degassed water was used as the coupling medium, however as water absorbs gas, the acoustic impedance changes drastically and reduces cavitation intensity and extraction effectiveness. This study explores alternative coupling materials with greater stability and simplified use.
The three materials evaluated were silicone, mineral oil, and ultrasound gel. We have measured the impedance values of these materials using a deionized water tank, transducer probe, and pulsar. We have also conducted DNA extraction with tissue samples using the FUSE device to validate the performance of each material. To evaluate longevity, the materials were put through multiple trials within a day and analyzed for effectiveness of DNA extraction over time.
This research is important since the ultimate goal is to give Malawi and other low income countries a device that can diagnose tuberculosis in a cheap and efficient way. Finding an effective coupling material will make the device more effective so more individuals can be diagnosed and put on a treatment plan as soon as possible.

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Impact of the Clean Water Act on Businesses

The Clean Water Act is a federal law that governs water pollution with the main aim of preserving the environment. The Clean Water Act was enacted in 1972 with the intent to regulate the amount of pollutants released into U.S waters. To achieve their goal, the government imposed restrictions that affect how businesses manage their production and by-products of production. Since the enactment of the Clean Water Act the government has successfully doubled the amount of clean water bodies. However, these policies, like many other regulations, have increased business costs. The main purpose of this proposed study is to find out if and how the clean water act impacts small businesses relative to large businesses. To determine this, we will collect total cost of production data from both large and small businesses (size determined by output). Then, we will compare the percentage of the total costs attributed to compliance with the Clean Water Act to normalize the data. The anticipated trend is that similar to other governmental regulations, the Clean Water Act disproportionately impacts smaller businesses. The expected results of this proposed research could unfold a business perspective that can be utilized in future amendments of the Clean Water Act to establish a level business playing field.

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Urbanization Organizes the Arginine Vasotocin (AVT) System in Developing Song Sparrows (Melospiza Melodia)

Kaul, S.; Fossett, T.; Dvali, L.; Lane, S.; VanDiest, I.; Sewall, K.

Urbanization drastically alters the developmental environment of wild animals. Early developmental environments are known to have life-long effects on an animal's behavior and neurophysiology, but are often understudied in the context of urbanization. Urban song sparrows (Melospiza melodia), for example, are consistently more aggressive than their rural counterparts, and have greater protein abundance of brain Arginine Vasotocin (AVT), a nonapeptide that is environmentally sensitive and known to mediate socio-sexual behaviors like aggression. However, whether these behavioral and neurophysiological differences between urban and rural song sparrows are underpinned by the differences in their developmental environment, remains unclear. Here, we used immunohistochemistry to compare AVT protein abundance in the lateral septum (LS) among developing urban and rural-living songbirds to determine how the developmental environment contributes to the organization of the AVT system, a vital first step towards understanding the neural correlates of aggression, a costly behavior in wild songbirds. We found that AVT levels vary by nestling age and developmental condition. Understanding the neural and behavioral correlates of urbanization will help us better understand the origins and degree of flexibility in brain and behavioral responses to human modified environments.

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Rewiring the Mind: A Neuro-Informed Approach to Substance Use Awareness

The Neuroscience of Drug Addiction course we're currently enrolled in integrates service learning into its curriculum. Our student group worked on a project in partnership with the Virginia Harm Reduction Coalition (VHRC). Drug safety and control has been a controversial and misperceived conversation for centuries, and as the prevalence of substance use disorders and overdose increases, so do our societal concerns. Within the US, overdose deaths since 2000 have nearly reached 1 million (NCDAS) and 68% of cities deemed substance abuse as the largest cause of homelessness (National Alliance to End Homelessness). Our project aimed to facilitate personal interactions with current users, several of whom experience homelessness, to learn about their experiences, areas of concern, and misunderstandings associated with their use. We gathered information through qualitative methods. This included open-ended, unstructured interviews that fostered rich, in-depth conversations. The results of these conversations were pooled together to uncover topic trends in the discussions. These findings guided the structured literature research that followed. Some topics that participants wished to understand include the neurobiology underlying tolerance, or "why what I take would kill my friend", the contaminants currently causing overdoses, and the differing impacts of various routes of administration for common substances. We are creating pamphlets on these trending topics for distribution among participants at the VHRC. Ultimately, our goal with each heartfelt conversation has been to support those facing this misconstrued mental disease by serving as an informational resource for those who wish to understand their use on a deeper level.

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Multi-site Assessment of Materials Waste in Senior Living Communities

A multi-site assessment of materials management practices was conducted across three senior living communities. Each facility underwent a 24-hour waste audit in which materials were sorted, weighed, and recorded by type. The goal was to quantify waste generation, identify contamination in recycling streams, and assess opportunities for diversion and education. Findings were consistent across the portfolio—recyclables were frequently misdirected to landfill waste, with Site A misdirecting 76.9% of recyclable materials. Food waste was a significant contributor to total waste volumes, especially post-consumer waste from dining services. Non-recyclable plastics and improper sorting were also prevalent, suggesting both infrastructural and behavioral barriers to sustainable waste practices. Recommended solutions included installing more accessible and clearly labeled recycling bins, introducing staff and resident education programs, eliminating single-use non-recyclables, and standardizing sustainable procurement practices across locations. This assessment established a foundational understanding of materials outflows across the organization and offers actionable insights to reduce landfill contributions and promote circular economy practices in senior living environments.

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Energy Use and Efficiency Opportunities in Senior Living Facilities

As part of a portfolio-wide sustainability initiative, this study evaluated energy consumption across three senior living communities located across Virginia. Each site was assessed through comprehensive facility walkthroughs and equipment audits, followed by energy modeling to estimate annual electricity demand categorized by equipment type and facility function. The analysis revealed high energy loads associated with outdated HVAC systems, inefficient lighting, and standard kitchen appliances. Recommendations varied by site but included common themes such as switching to LED or motion-activated lighting, replacing legacy equipment with Energy Star-certified alternatives, and implementing energy-conscious behavioral changes (e.g., unplugging unused electronics). Site C proposed timed lighting systems, while Site A and Site B emphasized efficient appliance upgrades. These insights provide a baseline for energy performance across each sites' portfolio and support strategic investment in retrofits and behavioral interventions. Ultimately, this energy assessment equips each site with data-driven recommendations to reduce operational costs, lower greenhouse gas emissions, and foster environmental stewardship within its senior living communities.

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"Hey Reddit, I'm worried about my grades. Is this normal?": An exploration of engineering students' discourse around grades and their impact on students "

Grades are the most common way to assess students' learning and mastery within a course. As the primary measure for competence in particular areas of knowledge or fields of study in educational settings, the grades students receive throughout their education often carry a large level of importance. Engineering students' grades and GPA have significance in students' lives in many ways beyond a simple measure of content understanding, as they also impact acceptance into universities, colleges or degree programs, scholarships or other financial awards, and sometimes internship or job offers throughout and after their college education. Given how engrained grades are into our educational systems and how pervasive they appear to be in nearly all aspects of engineering students' lives – in both positive and negative ways – our research team sought to explore the purpose, utility, and importance of grades through the lens of the primary stakeholders of grades and grading practices – engineering students. We have begun to employ grounded theory as a qualitative data methodology to explore how engineering students informally talk with one another about grades on Reddit – an online public forum. Specifically, we have begun our exploration by pulling all posts to the R/EngineeringStudents subreddit from the year 2022 that had the word "grade(s)(ing)" and identifying relevant posts and comment threads that would further inform our ongoing grounded theory model of Grade Centralization in engineering students' experiences.

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Investigating the Relationship Between Mammary Epithelial Cells and Immune Cell Extrusion and Milk Conductivity During Peak Lactation

Milk conductivity serves as a key indicator of udder health in dairy cows, particularly in detecting mastitis, a prevalent and costly issue in the dairy industry. This study investigates whether immune cell diapedesis and the extrusion of mammary epithelial cells (MECs) into milk correlates with milk conductivity during peak lactation (61-90 days in milk). In healthy cows, MEC extrusion and immune cell diapedesis occurs without damage to barrier integrity, excessive loss however may lead to tight junction disruptions, increasing ion influx into milk and serving as early markers of mastitis risk. Understanding this relationship between milk conductivity and cell loss may help identify early physiological changes linked to mastitis susceptibility.
Flow cytometry is used to analyze milk samples from two cohorts of seven cows each, collected over three consecutive days. Cell populations will be identified using antibodies targeting Butyrophilin to label MEC, and leukocyte common antigen to detect immune cells, with fluorescence conjugation for differentiation. NucFix Red stain will assess cell viability, while Hoechst stain will mark nucleated cells. Cell concentrations and total cell counts will be calculated using flow cytometry, somatic cell count, and milk yield data.
A positive and direct correlation is expected between cell presence and milk conductivity, as compromised tight junctions and increased immune response elevates ion concentrations. This research aims to validate milk conductivity as a reliable indicator of MEC and immune cell extrusion, potentially improving early detection and management of udder health issues in dairy cows.

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Computational Investigation of Huperzine A and Donepezil with Acetylcholinesterase

An estimated 6.7 million Americans are affected by Alzheimer's Disease. People with lower levels of acetylcholine are more prone to developing Alzheimer's because acetylcholinesterase (AChE) breaks down acetylcholine. Treatments for Alzheimer's include trying to inhibit the enzyme by stopping the binding to AChE. To prevent the breakdown of AChE, we tested multiple ligands and hypothesized that donepezil is a more effective inhibitor of AChE than huperzine A, due to its more favorable binding affinity and stronger interactions in the active site, leading to great inhibition of AChE.

Molecular docking and visualization were used to compare the binding affinity of huperzine A and donepezil to the protein. The major results that were observed showed that the original ligand was better suited for inhibiting the protein compared to the new ligand, donepezil. This could be seen through the greater length of residue interactions in the new ligand compared to the negative binding affinity of huperzine A.

These results showed that our hypothesis was not supported, and other ligands would need to be tested to find one that has a higher binding affinity than huperzine A. The AChE used in this experiment is found in organisms like Tetronarce californica, a species of electric ray. For future research this experiment should be repeated with the human version of AChE; this ensures that the results are applicable to humans and Alzheimer's. Additionally, molecular dynamics simulations could be utilized to verify the docked results in a realistic environment. This can be accomplished through programs like GROMACS.

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Evaluating the Effect of a Polarity-Altering Mutation on Glucokinase-Glucose Interaction

Glucokinase (GCK) regulates blood sugar levels by converting glucose to glucose-6-phosphate (G6P), making it a key enzyme in glycolysis and insulin secretion. Type 2 diabetes is a condition characterized by insufficient insulin production to regulate blood glucose. Mutations in glucokinase can impair its function, potentially contributing to the development of type 2 diabetes. Understanding these mutations—particularly amino acid substitutions that involve polarity changes—can provide insight into disease mechanisms and identify potential therapeutic targets. This study used molecular visualization to analyze the structure of E. coli glucokinase, introducing a mutation at residue 99 that replaced asparagine (N) with alanine (A). Structural comparisons between the wild-type and mutant proteins were conducted using docking methods to evaluate potential impacts on enzyme function. It was hypothesized that this polarity change would decrease the binding affinity between GCK and glucose; however, the opposite result was observed. The predicted binding free energy increased in magnitude from −5.8 kcal/mol to −6.5 kcal/mol, indicating that a single amino acid substitution can significantly influence protein-ligand interactions. Mutations near the glucose-binding site of glucokinase may play a critical role in altering glucose regulation, highlighting their relevance in the study of metabolic disorders such as type 2 diabetes.

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Reforming Trauma Training Materials for NRV School Systems

The Neuroscience of Drug Addiction course we're currently enrolled in integrates service learning into its curriculum. Trauma and Adverse Childhood Experiences (ACEs) are especially prevalent in the communities around us and have profound, long-lasting effects on individuals' brain development, behavior, and learning. Efforts are needed across the New River Valley (NRV) to inform community members on the impact trauma has on the human body and behavior and how to interact with each other in a helpful way. As a result of the growing need for trauma-informed education, this community-engaged project aims to enhance existing trauma training materials while incorporating current scientific research on the neurological effects of trauma. In March 2025, we engaged in a two-hour trauma-basics training session led by facilitators from the NRV Resiliency Network, which is the local Trauma Informed Community Network, to identify areas that need revision and lay the groundwork for a deeper exploration of useful trauma resources. Additionally, our student group collaborated with faculty and mentors to revise the informative trauma content for a variety of diverse audiences—including adult administrators and educators, as well as adolescents enrolled in schools. Students in this project aim to promote accessibility to these resources across age groups, as well as maintain relevance in each tailored approach to trauma training. An emphasis is placed on using age-appropriate language, a respectful tone, and visuals to meet audience needs. This project supports community education efforts and empowers us students to have a strong sense of science communication and trauma-informed advocacy.

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Effects of Hydroxyurea on the Molecular Structure and Stability of Sickle Cell Hemoglobin

Sickle cell anemia (SCA) is an autosomal recessive genetically inherited blood point mutation in which abnormal hemoglobin S (HbS) proteins are produced instead of normal hemoglobin A (HbA). This leads to the deformation of red blood cells into a sickle shape. This mutation impacts the flexibility of the red blood cells, leading to them getting stuck in small blood vessels, causing pain, organ damage, and a higher mortality rate. Hydroxyurea is an antimetabolite chemotherapeutic drug that has shown success as a treatment for SCA. Hydroxyurea induces the production of fetal hemoglobin (HbF), which does not sickle. Instead, it increases HbF levels, reducing HbS amounts and associated symptoms. Since the amount of HbF has increased, there is now a lower amount of HbS, reducing SCA symptoms. Our research used PyMOL (i.e., molecular visualization software) to investigate the interactions between hydroxyurea and sickle human hemoglobin. For this project, we examined (1) binding affinity and interactions of hydroxyurea on the HbS ligands, (2) conformational changes in HbS after the binding of hydroxyurea, and (3) the potential of hydroxyurea to prevent HbS polymerization. We anticipate hydroxyurea will increase the amount of HbF in the blood, making it harder for the red blood cells to sickle. These results will help to understand the interactions between hydroxyurea and HbS on a molecular level, which can help to know how to treat SCA and develop more targeted drug treatments.

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"The Budding Forager's Guide" - An Introductory Guide to Southwest Virginia's Edible Plants

There is already a rich culture of foraging in Appalachia, but current generations inherit less of this knowledge from the community. In recent years, foraging has become popular once again. Besides traditional foragers, many people are intimidated by the prospect of foraging due to safety concerns, legality, and a lack of background knowledge. However, with the right tools, foraging provides fantastic benefits: environmental stewardship, frugality, novelty, and health. We created an introductory foraging guide to selected plants in Southwest Virginia to bridge the gap that "plant blindness" and fear of the outdoors create for people who are intrigued by foraging.

This guide features 20 plant species, carefully selected to provide a diverse basis for developing a foraging experience. We researched other guides to determine the best strategies for conveying and depicting information. We assembled a rubric to assign difficulty levels to identification, foraging, and food preparation. The guide is divided into three sections: "Easy Pickings", "Spice it Up", and "Rich History", which include easy-to-harvest plants, species with unique uses, and those with significant cultural or historical significance. We designed colorful taxonomic illustrations for easy identification by representing the desired traits and life stages. Additionally, we tested the foraging guide on novice foragers.

This guide will be available in both PDF and hard copy booklets for accessibility. Our foraging guide will stimulate interest in plants, their cultural significance, and the ecology of Southwest Virginia. We hope to decrease fears of safety or legality by providing an approachable introduction to foraging.

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

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Symbiotic Strength: Evaluating Mycorrhizal & Nitrogen-Fixing Influences on Plant Fitness

Plant-microbe interactions play a crucial role in ecosystem functioning and agricultural productivity. However, the complex interplay between plants, mycorrhizae, and nitrogen-fixing bacteria remains incompletely understood, particularly in terms of their combined effects on plant growth and biomass allocation. This study aimed to address this knowledge gap by investigating the effects of mycorrhizae and nitrogen-fixing bacteria on the growth of Andropogon gerardii and Trifolium repens plants. Using a two-way ANOVA with replication, various biomass parameters were examined. Results revealed significant differences in above-ground ($p = 0.005650955954$) and below-ground ($p = 0.003338810513$) biomass length for nitrogen fixer presence. Additionally, significant differences were observed in the root to shoot length ratio for both nitrogen fixer ($p = 0.0001155529061$) and mycorrhizal presence ($p = 0.007805981533$). However, no significant effects were found for the interaction between mycorrhizae and nitrogen fixers across other measured parameters. These findings highlight the impact of Trifolium repens on plant growth while suggesting minimal influence of mycorrhizal presence on biomass allocation under the given conditions. The study contributes to our understanding of plant-microbe interactions and their effects on biomass allocation, emphasizing the need for further investigation under varied experimental conditions and extended growth periods to fully elucidate these complex relationships.

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Functional Characterization of the Arabidopsis AAP Family Using a Yeast Expression System

Amino acid transporters are essential components of nitrogen metabolism in plants, responsible for the uptake and redistribution of amino acids throughout the plant body. They play crucial roles in growth, development, stress responses, and the loading of seeds with essential nutrients. This project aims to characterize the substrate specificity and transport efficiency of the eight amino acid transporters of Arabidopsis from the AAP family (AAP1–AAP8) using a yeast heterologous expression system. The overarching goal is to better understand how these transporters contribute to amino acid allocation and response to various biotic and abiotic stresses.

Each AAP gene was cloned into a yeast expression plasmid and introduced into a yeast strain deficient in native amino acid uptake. Growth assays were performed in minimal media containing individual amino acids as the sole nitrogen source. Growth was measured as colony size. Doubling times were also determined as a proxy for transport efficiency, allowing for quantitative comparisons of substrate preferences among the AAPs. Preliminary results demonstrate that members of the AAP family exhibit a range of substrate specificities, with some transporters showing broad uptake capacity and others transporting a narrower subset of amino acids.

These findings enhance our understanding of the functional diversity within the AAP family and provide insight into the molecular mechanisms governing amino acid transport in plants. By identifying key differences in transporter activity, this work may inform future efforts to engineer crops with improved nitrogen use efficiency and resistance to nutrient-scavenging pathogens. Additionally, this study lays the groundwork for structure-function relationship analyses using the yeast system.

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Examining Additive Risk from Prenatal Substance Use and Parental Mental Health in Predicting Child Mental Health Diagnoses

Prenatal substance use is a common problem in our society. The effects of various substances commonly used during pregnancy have been studied extensively, with little understood about the long-term behavioral effects that may present. Taking into consideration maternal mental health symptoms and the types of substance used (prescription medications, caffeine, alcohol, tobacco, illicit drugs) this study sought to utilize a database of comprehensive psychoeducation assessments to examine mental health diagnoses (ADHD, anxiety, autism, depression, disruptive behavior, learning) among youth exposed to substances in utero versus those who were not. Participants include 254 children and adolescents (4-18 years; M=11.08; 68.9% assigned male at birth; 85.4% White; M family income=$78,836) who came to the Virginia Tech Child Assessment Clinic. Mothers reported on their mental health symptoms and substance use in utero as part of intake procedures. Regression analyses were run in SPSS with maternal mental health and all substance use variables included in each model; each diagnosis was examined in separate models. Alcohol use, smoking, non-prescribed drugs, and caffeine use were all associated with children being more likely to have a disruptive behavior disorder diagnosis. In contrast, prescribed medication use was associated with children being less likely to be diagnosed with a disruptive behavior disorder. Maternal alcohol use was also positively predictive of depression diagnoses. Surprisingly, prenatal substance use was unrelated to all other mental health diagnoses in the current sample. Instead, maternal mental health significantly predicted anxiety and autism diagnoses. Clinical implications and limitations of the current study will be discussed.

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Refining Resources to Educate the Youth on the Neuroscience of Opioids and the Dangers of Fentanyl

The Neuroscience of Drug Addiction course we're currently enrolled in integrates service learning into its curriculum. This project aims to improve fentanyl education and prevention efforts among the youth in Southwestern Virginia. This region has been deeply affected by the opioid epidemic, and fentanyl-related overdoses and fatalities have continued to rise nationwide amongst this age group. To address this, there is a pressing need for engaging and scientifically accurate educational materials regarding fentanyl and opioid use. Our project remodels an existing presentation by updating content on how opioids affect the brain and body and incorporating age-appropriate elements to enhance retention. To do this, our team evaluated the original presentation and suggested edits to make it more digestible. We redesigned the presentation to include more relevant visuals, facts, and situations that resonate with the youth. We also added information on the neurobiology of opioids and fentanyl in a scientifically accurate, yet understandable way. The updated presentation will be delivered to high school students within Southwestern Virginia. The anticipated outcome is an impactful presentation that informs students about the dangers of fentanyl, where it is often found, and how it acts on the body. Ultimately, this project aims to increase harm reduction efforts by enhancing existing educational resources that target a vulnerable age group in an opioid-affected community.

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Assessing What Factors Affect Our Value of Differently Processed Food

Ultra-processed foods (UPF), characterized by their high degree of chemical and industrial processing, are comparably cheaper to minimally processed foods (MPF) and make up 58% of calories consumed in the average US diet. However, consumption is associated with higher BMI, obesity, and related comorbidities.

As part of a larger study, this project aims to understand the relationship of food processing and food value. 41 healthy weight participants (ages 18-45) underwent a Becker-DeGroot-Marschak auction paradigm, where they bid on 28 pictures of food (14 UPF and 14 MPF) that appear in randomized order. The goal of this analysis is to determine what individual or financial variables explain individuals' willingness-to-pay (WTP). Their WTP was assessed after each picture, and it was concluded to not differ between UPF and MPF food groups. There was a positive correlation between WTP and liking of most foods, regardless of the level of processing ($p<0.05$). Results of this analysis will help us understand how food choices are made and may have implications for dietary guidelines in the US.

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Virginia Tech/Psychology

Understanding the Relations between Social Responsibility and College Students' Prosocial Tendencies

Prosocial behaviors are voluntary actions intended to benefit others (Eisenberg et al., 2015). These behaviors can be categorized into six specific types based on their underlying motivations: (1) public (performed in the presence of others to gain social approval or recognition), (2) emotional (performed in emotional situations), (3) anonymous (performed without others knowing), (4) compliant (performed in direct response to a request from someone else), (5) altruistic (performed with selfless motives without expecting anything in return), and (6) dire (performed in emergency situations) (Carlo et al., 2003; 2010). Previous research has been showed that there is a significant relation between prosocial behaviors and social responsibility, but most of them focused on specifically children and adolescents, and on global prosocial behaviors, not specific subcategories (O'Connor & Cuevas, 1982). Thus, this study examines the relations between social responsibility and six types of prosocial behaviors among college students. The sample consisted of 1,105 college students (Mage = 19.32; 63.9% female; 79.3% White; 9.7% Black). Hierarchical regression analysis revealed that social responsibility is significantly and positively related to emotional, anonymous, compliant, altruistic, and dire prosocial behaviors. In contrast, it is negatively related to public prosocial behavior. These findings contribute to our understanding that social responsibility is a significant predictor of specific types of prosocial behaviors among college students. Further, it emphasizes the importance of cultivating a sense of social duty to promote positive behaviors.

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

Hannah Levy

Virginia Tech/International Studies

Policy-Driven Inequities: How European Trade Regulations Deepen Class Divides in the African Cocoa Industry

This study examines how European trade regulations contribute to economic disparities within the African cocoa industry, disproportionately affecting smallholder farmers in Côte d'Ivoire and Ghana. By analyzing policies such as the EU Cocoa and Chocolate Directive, sustainability certification programs, and the Common Agricultural Policy (CAP), this research investigates the socio-economic and market impacts of these frameworks. While these policies aim to promote sustainability and ethical sourcing, their high compliance costs and complex requirements often exclude smallholders, reinforcing systemic class-based inequities.

Using a mixed-methods approach, this study combines qualitative case studies and stakeholder interviews with quantitative analysis of trade data, pricing trends, and certification cost structures. The dataset includes interviews with 25 farmers, intermediaries, and cooperative leaders, as well as a review of policy documents and trade statistics. Findings indicate that certification fees, traceability mandates, and tariff structures limit smallholder access to premium markets, with certified farmers earning 20–30% more while the majority remain excluded. Statistical analysis of tariff impacts further reveals that CAP regulations disproportionately benefit European processing industries, restricting local value addition in cocoa-producing nations.

The anticipated outcomes of this research emphasize the urgent need for policy reforms that create a more inclusive cocoa industry. Proposed solutions include tiered certification fees, subsidies for smallholder compliance, and CAP tariff reductions on processed cocoa products to enable greater economic participation. By bridging the gap between global sustainability goals and smallholder realities, this study advocates for trade frameworks that foster economic viability, social equity, and environmental sustainability.

Mentor(s): Ivy Liu, Public Policy Leadership, Virginia Tech

Tatum Lonack
Virginia Tech/Plant Science

Late Bloomer: Investigating Flowering Times in Culinary Plants in Response to Climate Change

Foraging for culinary plants has a rich history and cultural importance within the Southern Appalachian region. Native edible plants have been used for alternative medicine and culinary dishes throughout multiple generations and continue to be an important part of culture. Black huckleberry, Gaylussacia baccata, is an edible native species that has been used in many dishes such as pies, jams, and teas. Changes in climate throughout the region could impact the phenology and development of many species. These changes can impact species' fitness and interactions within their ecological community. Changes to a species’ phenology, including flowering time and flowering stage, are easier to identify visually. We aim to determine if black huckleberry phenology is impacted by climate change. A combination of iNaturalist observations and herbaria records were used to obtain dated specimen photographs. Interfaces such as iNaturalist and Seek have connected citizen science and researchers, allowing for the scope of research and data collection to be expanded into new collection sites. Species observation images were scored on a five-point scale from no flowering structures to full flowering with fruit and were used to predict species’ trends in flowering. We identified trends in flowering time by correlating the phenology data with location temperature data. Results are expected to show an earlier flowering time in black huckleberry as seen in similar species in surrounding areas. Shifts in flowering time due to warming can impact reproductive fitness and can be used to predict future species' habitats and survival as temperatures continue to change.

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

Alex Loria
Virginia Tech/Wildlife Conservation

Using environmental-DNA to detect differences in plant-pollinator interactions across the Mariana Islands

Understanding how invasive species alter island ecosystems requires accurate and efficient methods for monitoring changes in plant communities. This project uses environmental DNA (eDNA) to detect and compare plant-pollinator interactions across Guam and Saipan. We hypothesize that these islands differ significantly in pollinator species composition due to the introduction of the brown tree snake (Boiga irregularis) on Guam. As a result of this introduction, all native bird species are functionally extinct on the island, with several extant populations limited to urban areas, and arthropod communities have changed too. By using eDNA methodologies, we begin to assess the degree to which the pollinator communities in limestone forests differ between islands, and how this varies by tree species. Floral samples were collected in 1L bottles and water from native limestone forests across multiple sites on both islands. Each sample solution was run through a vacuum manifold to collect any eDNA fragments on a 0.8 µm filter and stored in CTAB buffer for shipment to Virginia Tech. The DNA was extracted using chloroform-isoamyl and amplified using MCO1 and ANML primers to target the CO1 gene in arthropods. Once the samples have been sequenced, we expect to identify specific plant-pollinator interactions for each tree species. We will then be able to ascertain how potential pollinator visitation has changed on Guam due to the invasive snake introduction.

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

Matthew Louvet Jr
Virginia Tech/Fish Conservation

How Regulated are Recreational Fisheries in the Great Lakes?

Rules and regulations are used to control and protect fish species commonly harvested by anglers through different tiers, including bag limit, size limit, and seasonal restriction. However, there is limited understanding of how fishing rules and regulations align with recreational anglers' actual behavior regarding the proportions of fish species they catch or harvest. To address this knowledge gap, we used a creel survey to collect data on commonly caught species by anglers from five metropolitan areas around Erie and Ontario Lakes. Intercept surveys were conducted at popular fishing locations while online surveys were distributed through flyers in local tackle shops and angler Facebook groups. Overall, 15-34% of reported catch was species not regulated under any tiers of recreational fishing rules. Of the remaining catch reported by anglers, all reported species were subject to bag limits, 77% to seasonal restrictions, and 70% to size restrictions. We also found that 19% of the species that anglers reported were either incompletely or incorrectly identified. These findings indicate that while a notable portion (potentially one-third) of the fish caught by anglers is unmanaged, further research is needed to explore whether this indicates new recreational fishing opportunities or reflects a change in anglers' catch preferences in the Great Lakes. Additionally, the high rate of species misidentification suggests that anglers' limited knowledge of fish species could undermine the effectiveness of fishing regulations.

Mentor(s): Leandro Castello, Fish and Wildlife Conservation, Virginia Tech
Leandro Castello, Department of Fish and Wildlife Conservation at Virginia Tech
Mahatub Khan Badhon, Department of Fish and Wildlife Conservation at Virginia Tech

Becca Lowe
Virginia Tech/General studies

Stand Still! Comparing Positive and Negative Reinforcement in Equine Training

This study examined the effects of PR and NR on equine behavior at the mounting block, a critical task for rider safety. Thirteen horses were assessed using a scoring system to measure their ability to remain still next to the mounting block, with baseline tests conducted prior to training. Heart rate was monitored as an indicator of stress levels throughout the experiment. The horses were divided into two groups: one trained with PR, which involved food rewards for standing still, and the other trained with NR, which used light lead rope pressure to correct movement. Each training method was applied across three trials. No statistically significant differences were found in heart rate changes before and after the trials, nor in the horses' behavior scores between the pre- and post-training phases, or between the PR and NR groups. Future research could involve replicating this study with a larger sample of more homogeneous horses, extending the duration of training, or exploring the application of PR in other areas of equine training.

Mentor(s): Katharine Davis, Blacksburg High School

Keaton Lucas
Virginia Tech/Biochemistry
Emma Rose
Virginia Tech/Biochemistry
Jenna Zekra
Virginia Tech/Biochemistry
Brianna Mitchell
Virginia Tech/Biochemistry

Enhancing Acetylcholinesterase Inhibition: A Structural Modification of Huperzine A

Alzheimer’s disease is a progressive neurodegenerative condition associated with a decline in memory and cognitive function. Research has shown that the brains of individuals with Alzheimer’s have lower levels of acetylcholine compared to those without the disease. Acetylcholine is naturally broken down in the body by the enzyme acetylcholinesterase (AChE), leading to the development of several drugs, such as donepezil and huperzine A, to inhibit this enzyme. However, huperzine A has limited affinity for AChE, which reduces its effectiveness in preventing the breakdown of acetylcholine. The goal of this experiment was to develop a ligand with greater interaction strength at the AChE active site to improve therapeutic outcomes. A modified ligand was designed with the addition of a carbon ring and the substitution of two nitrogen atoms with oxygen atoms to increase electronegativity and enhance interactions with the target site. Computational analysis showed that the new ligand had a more favorable predicted binding energy, improving from 10.0 kcal/mol to 11.3 kcal/mol, reflecting a 13% increase in interaction strength. These results suggest the modified ligand could more effectively inhibit AChE and help maintain acetylcholine levels. A drug therapy using this new ligand may be more potent for managing the symptoms of Alzheimer’s disease.

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

Emma Lucier
Virginia Tech/Biological Sciences
Alejandra Flota
Virginia Tech/Water: Resources, Policy, and Management

Influence of Dredging on Water Chemistry in a Retention Pond

Retention ponds aid flood reduction and mitigate excess nutrient loads, enhancing water quality downstream. The Duck Pond underwent sediment dredging in 2024 from April to August. We collected surface water samples before, during, and after dredging to gain a better understanding of the changes in water chemistry downstream of the pond. Grab samples and sensor data from 2021-2025 measured dissolved organic carbon (DOC), nitrate (NO_3), ammonium (NH_4), and phosphate (PO_4). Before dredging, DOC and NH_4 were higher downstream relative to inlets, while NO_3 was lower. PO_4 was higher upstream, and less variable downstream. Inlet-outlet differences before dredging were statistically significant for DOC, NO_3, and NH_4 ($p<0.05$). During dredging, NH_4 export increased relative to inputs. DOC, NO_3, and PO_4 increased minorly during dredging, but only NH_4 showed statistical differences during dredging ($p<0.05$). After dredging, NH_4 and PO_4 decreased at the outlet and were lower than before dredging. NO_3 steadily increased across dredging stages, while DOC remained relatively stable. Ongoing calculations will provide insight into the dynamics of nutrient retention and the changed efficiency of the Duck Pond in mitigating nutrient export downstream.

Mentor(s): Erin Hotchkiss, Department of Biological Sciences, Virginia Tech
Katherine X. Perez-Rivera, Department of Biological Sciences, Virginia Tech
Carla López Lloreda, Department of Biological Sciences, Virginia Tech

Ian Macrea
Virginia Tech/General studies

Repeated Impacts on Cycling Helmet Efficacy

Although cycling helmets are intended to be replaced after every impact, cyclists often continue to use impacted helmets despite liner damage, polystyrene foam deformation, and shell cracking. Evidence suggests that prior impacts worsen helmet efficacy in the context of preventing concussions. In the present study, two Bell Vert 2.0 helmets were equipped to a National Operating Committee on Standards for Athletic Equipment (NOCSAE) Hybrid III head-and-neck surrogate and struck with a pendulum impactor in order to collect peak linear acceleration (PLA) and peak rotational acceleration (PRA). Front boss, side, and back locations were tested. One helmet (BV1) experienced three low energy (3.6 m/s) impacts on the front boss, three high energy impacts (5.4 m/s) on the side, and three low energy impacts on the back. The second helmet (BV2) also experienced three impacts in each of these locations but with the opposite energy level for the front boss, side, and back. Data were analyzed using a two-way ANOVA test, two Tukey HSD tests, and a T-test. The two-way ANOVA test resulted in a statistically significant overall p-value of under 0.0001, with the results of the following tests being significant as well. Repeated impacts increased concussion risk in all impact locations, at all energy levels, and when considered with both impact location and energy level combined. This strongly suggests that cyclists should replace their helmet after every impact. More research investigating the effects of repeated impacts is warranted.

Mentor(s): Barry Miller, Department of Biomedical Engineering and Mechanics, Virginia Tech
Katharine Davis, Blacksburg High School

Ingrid Macrea
Virginia Tech/General Studies

The Accuracy of an American Sign Language-Recognition Deep Neural Network (Transfer Learning Approach) under Simulated Healthcare Conditions

This study evaluates the accuracy of the deepASL deep neural network in recognizing ASL fingerspelling under healthcare-specific conditions, aiming to address communication barriers faced by Deaf and Hard of Hearing (DHH) individuals in medical settings. Effective communication in healthcare is essential, yet DHH individuals often experience challenges due to limited interpreter availability, inadequate physician awareness of DHH culture, and technological limitations in ASL recognition. To assess deepASL's performance, the network was tested using an ASL alphabet dataset of 87,000 images across various conditions, including fine hand tremors, right- and left-hand dominance, and four glove colors (clear, pink, green, and purple). Each letter was signed three times under controlled experimental conditions, generating a dataset that measured recognition accuracy. Results indicated that fine hand tremors significantly decreased recognition accuracy ($p=0.02$), while no difference was observed between right and left-hand use ($p=0.5$). Among glove colors, the purple glove significantly improved recognition accuracy ($p=0.006$), whereas the clear glove resulted in the lowest accuracy ($p<0.001$). These findings suggest that factors such as hand stability and visual contrast affect the performance of ASL recognition models, presenting challenges for their real-world application in healthcare environments. Improving ASL recognition technology could reduce communication barriers, ensuring better access to medical care for DHH individuals. Future research should focus on optimizing deep learning models to enhance ASL recognition accuracy in dynamic healthcare conditions, ultimately contributing to more inclusive and effective healthcare interactions for the DHH community.

Mentor(s): Katherine Davis, Blacksburg High School

Mali Madison
Virginia Tech/Biological Sciences
Nethra Rajeshkumar
Virginia Tech/Computational and Systems Neuroscience
Madeline Stefano
Virginia Tech/Computational and Systems Neuroscience

Exploring Neural Resilience: The Role of Cognitive Reserve in Behavioral and Brain Outcomes Following Cognitive Training

Cognitive decline is common in older adults, but its rate and extent vary. Cognitive reserve, measured by the Cognitive Reserve Index (CRI), reflects life experiences that help maintain cognition despite aging-related brain changes. One brain area linked to cognitive reserve is the locus coeruleus (LC), a brainstem nucleus responsible for norepinephrine (NE) production, and maintaining LC-NE system integrity may prevent cognitive decline during aging. This study examines whether CRI predicts differences in response time on the Attention Network Task and LC neural activation following cognitive training. We hypothesized that participants' response time and neural activation would improve following cognitive training. We also hypothesized that higher cognitive reserve would be linked to greater improvement in attention performance and neural activity following training.

Data was collected from 25 older adult participants (68% women and 32% men) across two fMRI sessions spaced two weeks apart, with ten days of cognitive training in between. In addition to the behavioral data, response time changes and LC activation changes across scans were analyzed. A t-test demonstrated improvements in attention-task response time ($p = 0.039$) following training, and a linear regression showed a marginally significant association between cognitive reserve and response time improvement ($p = 0.073$). fMRI analysis revealed decreased LC activation following training ($p = 0.029$), and finally, a linear regression was used to identify the association between cognitive reserve and LC activation changes ($p = 0.011$). These findings may have implications for how cognitive reserve impacts neural responses to cognitive interventions during aging.

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

Mia Mamun

Virginia Tech/Mathematics

Computer Vision and Machine Learning for Earth Observation onboard Nanosatellites

This project explores the feasibility of using cascade classifiers for object detection in satellite-based Earth observation, focusing on execution time and accuracy compared to convolutional neural network (CNN) approaches such as YOLO. The central research question examines whether cascade-based methods can deliver faster processing times without significantly compromising detection accuracy, making them suitable for use on low-SWaPC nanosatellite platforms. To investigate this, a cascade classifier and a YOLO model were each trained on the CIFAR-10 dataset and tested on a separate, custom dataset of images. The cascade classifier showed significantly faster execution times, particularly at lower image resolutions, though it generally produced lower accuracy compared to the YOLO model. However, YOLO only began to outperform the cascade classifier in execution time only when processing extremely high-resolution images (e.g., 4K and above). These findings suggest that cascade classifiers, despite lower accuracy, may offer a practical tradeoff in environments where computational resources are limited and real-time performance is critical. The results demonstrate the potential for using lightweight object detection methods in small satellite systems, offering a balance between speed and effectiveness that aligns with the constraints of onboard Earth observation tasks.

Mentor(s): Bradley Denby, Aerospace and Ocean Engineering, Virginia Tech

Madilyn Marsden
Virginia Tech/General Studies

ECE Study Targeted at At-Risk Preschool Programs

This study examines the relationship between the attendance of MCPS funded preschool education, and current academic statistics on these students through their senior year in high school by reviewing test scores (SAT), and GPA of 757 MCPS students. This study analyzes whether or not a student's participation in this county funded, at-risk program, had a significant effect on their current academic success. The hypothesis of this study is that students who participated in the MCPS at-risk childhood education programs will demonstrate a statistically significant difference in both SAT scores and overall GPA compared to those who did not participate, as a result of the difference of preschool experience. To test this hypothesis, the study analyzed statistical data from over 700 students, comparing their early education backgrounds with their current academic achievements: SAT Scores and GPA.
Statistical Analysis showed that there is a large significance in the overall GPA averages between these two groups, but no difference between SAT averages. These findings suggest Montgomery County's at-risk pre-K programs result in students who perform at a lower level in highschool, based on GPA, than their peers who did not attend this program. This highlights the importance in the understanding of the types of education preschool-aged children are receiving, and the long term effects each may have.

Mentor(s): Katherine Davis, Blacksburg High School

Lilith Martin
Virginia Tech/Wildlife Conservation
Emma Hildebrand
Virginia Tech/Wildlife Conservation

Understanding the assembly of plant-seed disperser interactions along elevational and seasonal gradients in Central Appalachian Mountains

Animal-mediated seed dispersal is a key ecosystem service that maintains plant diversity and distribution while contributing to ecosystem resilience. Most of our understanding of plant-seed disperser networks comes from tropical regions and there is limited knowledge of temperate forests, particularly from North America. Changes in plant phenology and animal migrations can trigger mismatches and rewiring of plant-seed disperser interactions, challenging plants' ability to establish suitable habitats and cope with climate change. Appalachia is the most biodiverse ecosystem in North America, but no community-wide seed dispersal networks have been assembled in this region. Through this study, we aim to generate baseline information on plant-seed disperser interactions along a 2000ft elevational gradient in Central Appalachia across multiple seasons. We monitored 18 fleshy-fruiting plant species (129 individuals; 6 trees, 7 shrubs, 2 climbers, 4 herbaceous plants) between May and December 2024 using motion-triggered cameras. We reviewed 160 hours of footage to record frugivore visitation and fruit-handling behavior on each plant. During the first screening, we recorded 2994 visits by 62 frugivore species from 19,800 total files. We predict a higher number of interactions at the higher elevation given the high diversity of fleshy-fruiting plants. We also expect summer ripening plants will primarily be dispersed by summer resident birds and fall ripening plants will be dispersed by migratory birds. Findings from this study will improve knowledge of seed dispersal networks in a temperate forest and will provide critical insight for creating future ecosystem management plans in the face of global change.

Mentor(s): Haldre Rogers, Department of Fish and Wildlife Conservation, Virginia Tech
Abir Jain, Department of Fish and Wildlife Conservation, Virginia Tech

Trenton Matthews
Virginia Tech/Human Development and Family Sciences

Becoming a man: How sons of single mothers construct masculine identities

This study examines how men raised by single mothers understand and perform masculinity, emphasizing the emotional complexities that shape their gender identities. Traditional scholarship has often positioned fathers as essential to masculine development; however, feminist perspectives challenge this view, framing masculinity as a fluid, socially constructed practice that can be modeled by individuals of any gender. Using qualitative interviews with 11 participants who were raised solely by their mothers, this research employs inductive thematic analysis to uncover recurring themes and alternative experiences of precarious manhood—the notion that masculinity must be continuously demonstrated and validated. Participants drew on their lived experiences to articulate how they navigate and embody masculinity in the absence of a resident father figure. In these findings, expressions of emotional support and well-being emerged more frequently than conventional masculine tropes such as financial provision and security, suggesting a broader, more relational understanding of what it means to be a man.

Mentor(s): Tekisha Rice Wallace, Human Development and Family Sciences, Virginia Tech
Aran Garnett-Deakin, Human Development and Family Sciences, Virginia Tech

Alexander McDowell
Virginia Tech/Microbiology
Marah Leslie
Virginia Tech/Chemistry
Jonathan Hing
Virginia Tech/Political Science

Sickle Cell Disease, Gene Therapy, and Immune Response to Malaria

Sickle Cell Disease (SCD) is a recessive genetic condition that causes deformation of red blood cells, anemia, vascular blockage, reduced life expectancy, and immunocompromisation. However, previous research suggests that nonsymptomatic SCD-gene carriers may express immune resistance to the malaria parasite. The primary goal of this study would be to determine if fetal hemoglobin replacement therapy can improve immune response in SCD-model mice or induce similar malaria resistance to that of SCD carrier mice. We predict that antibody production will increase when treated patients are exposed to a malaria vaccine compared to the control. Extraction of stem cells bone marrow of SCD-model mice. After using CRISPR-Cas9 to remove BCL11A, an inhibitor of the γ-globin gene, reimplantation of stem cells. The patient would be given a small dose of malaria vaccine, and an ELISA test would be used to measure malaria-specific antibody concentration. We expect that malaria-specific antibody production will be increased due to an increase in functional red blood cells, and not as a result of the same mechanism seen in SCD carriers. We will control for this by testing responses to other vaccines as well. At face value, the results of this experiment could further prove the efficacy of gene therapy as a long-term SCD treatment. The next step should be to repeat this experiment with human patients. Future research should likely target finding a method of utilizing the SCD gene to fight malaria, which would likely require HBB gene editing in very early embryonic development.

Mentor(s): Amanda MacDonald, University Libraries, Virginia Tech

Kyle McKay
Virginia Tech/Biomedical Engineering
Safiya Akpinar
Virginia Tech/Public Health

Teresa Thorton
Virginia Tech/Public Health
Jackson Lawrence
Virginia Tech/Civil Engineering
Aileen Lee
Virginia Tech/Public Health

Team Malawi - GIS Detection of Schistosomiasis Water Sampling and Collection

Waterborne pathogens, such as Schistosoma haematobium, present significant public health risks in freshwater environments, particularly in regions like Malawi, where schistosomiasis remains endemic. The Team Malawi research initiative at Virginia Tech aims to develop a contactless, aerial drone-based water sampling system to enhance pathogen surveillance while reducing human exposure risks.

The purpose of this project is to bridge the gap between GIS technology and field-based epidemiological studies by integrating an autonomous drone system capable of collecting water samples from remote and high-risk areas. This innovation can potentially improve the efficiency and safety of environmental monitoring for waterborne diseases, informing public health interventions and water safety policies.

Our approach involves designing and testing a custom-built drone equipped with a water collection mechanism and GIS mapping for targeted sampling locations. Field trials in Malawi, conducted in collaboration with institutions such as Malawi University of Science and Technology, UNICEF, and the Malawi Liverpool Wellcome Programme, have provided valuable insights into the feasibility and optimization of drone-assisted sampling. Additional efforts focus on fostering international collaboration, including potential expansion to waterborne disease surveillance in the Amazon River basin.

Preliminary results indicate that the drone system successfully retrieves and preserves water samples suitable for pathogen analysis, demonstrating its viability as a scalable solution for schistosomiasis monitoring. Anticipated outcomes include refining the system for broader environmental applications, securing a patent for the water collection device, and expanding partnerships with research institutions such as Duke University. Through this work, Team Malawi contributes to the development of innovative, technology-driven public health strategies in resource-limited settings.

Mentor(s): Andre Muelenaer, Professor of Practice, Virginia Tech

Zoe Miloszewski
Virginia Tech/Biomedical Engineering

Quantifying Histotripsy Effects on Tendon Integrity

Osteosarcoma (OS) is the most common form of bone cancer, yet current treatment approaches often fall short of preserving patients' quality of life. Typical treatments include amputation or limb-salvage surgery and chemotherapy, though each of these approaches has significant limitations. Histotripsy, a non-invasive, non-thermal, focused ultrasound therapy, mechanically ablates tumors via an ultrasound-generated cavitation bubble cloud. Histotripsy's ability to precisely and accurately target tumors makes it an excellent emerging treatment for OS. To ensure its clinical safety, it's important to evaluate the effects of histotripsy on surrounding soft tissue structures, particularly tendon integrity. In this ex vivo study, canine extensor tendons were indirectly treated with histotripsy at both clinical (1000 pulses per point (ppp), n = 8) and supraclinical (4000 ppp, n = 8) doses. An untreated control group (n = 8) was also included for comparison. Tendons were imaged using grayscale and shear wave elastography (SWE) before and after treatment. Image texture analysis was conducted in three regions: the treated medial zone and adjacent proximal and distal regions, providing insights into tissue integrity by quantifying subtle, visually undetectable changes. Texture analysis quantifies tissue structure using pixel-wise statistical analysis of greyscale echogenicity, allowing it to be combined with other assays for a more robust classification of tendon properties. Preliminary findings suggest that 4000 ppp treatments may cause structural damage, indicated by decreased echogenicity and variance. Ongoing analyses of 1000 ppp-treated tendons are expected to confirm the safety of clinical-dose histotripsy, supporting further research on the clinical applications of histotripsy for OS treatment.

Mentor(s): Vincent Wang, Biomedical Engineering and Mechanics (BEAM), Virginia Tech
Megan Gulian, Virginia Tech Biomedical Engineering and Mechanics, Virginia Tech
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Lance Mitchell
Virginia Tech/Microbiology

Dynamics of GacS and RetS Interactions in Pseudomonas aeruginosa: the Role of GacS S-Helix Kinking in Biofilm Formation

Pseudomonas aeruginosa is a gram-negative opportunistic pathogen responsible for various antibiotic-resistant infections. The transition between acute and chronic infection is regulated by two transmembrane histidine kinases – GacS and RetS. GacS binding to RetS is required to suppress biofilm formation and promote acute infection. Molecular dynamics studies suggest that GacS kinks substantially within its S-helix region, facilitating interactions with RetS. To test this, mutations were made at the predicted sites to prevent kinking. Consistent with our model, it was found that these mutations caused upregulated biofilm formation. However, we also need to test the alternative model that mutations in the GacS S-helix region directly disrupt the GacS-RetS interface. I am testing this alternative model through Microscale Thermophoresis binding studies of RetS with mutant and wild-type GacS constructs.

Mentor(s): Florian Schubot, Department of Biological Sciences, Virginia Tech

Emily Mix
Virginia Tech/Psychology

Disordered Eating and Feelings of Shame Associated With Social Media Use By Gender

Young adults view eating-related content on social media at high rates and are at elevated risk for disordered eating. Shame is an eating disorder risk factor and viewing eating-related content may elicit shame given the perceived discrepancy between the viewer's body shape and that of the creator, which is generally a thin woman. As such, higher levels of shame may strengthen the association between social media and eating disorder distress. We investigated this using data from N=485 undergraduates (M age=19.04 years, 72% women, 68% white) who completed measures of shame, eating disorder distress, and social media use. The outcome variable was eating disorder distress and shame. Frequency of viewing of eating-related content, shame, and the product of the two were predictors. Gender was a covariate. Results demonstrated shame and frequency of viewing of eating-related content on social media were independent predictors of eating disorder distress. The interaction was not significant.

Mentor(s): Heather Davis, Psychology, Virginia Tech

Rowan Moles
Virginia Tech/Biological Science
Sasha Lee
Virginia Tech/Environmental Data Science
Jesse Gutierrez
Virginia Tech/Water: Resources, Policy, and Management
Jay Johnson
Virginia Tech/Biological Science
Jordyn Small
Virginia Tech/Biological Sciences

Soil Quality of Worm Compost

Climate change is becoming a more prevalent problem; one contribution to rising temperatures is food waste. Decomposed food waste releases major air pollutants such as carbon dioxide and if the food is incinerated, sulfur dioxide and nitrogen oxides. Economic growth and industrialization in both developed and developing countries have led to an increase in food consumption. With this increase in food consumption, there is an increase in food waste, but the current methods of discarding food waste return minimal amounts of nutrients to the soil. There are roughly 2 billion tons of organic solid waste produced annually around the world, by 2025 that amount is expected to be 3 billion tons. Composting is a method of letting food break down naturally through decomposition. Adding worms to composting, called vermicompost, the resulting product has a higher nutrient value, lower plant toxicity, and is rich in growth hormones for plants. The following experiment explores the effect of differing levels of humidity on vermicomposting. Each bin was composed of dirt found on Virginia Tech campus, as well as leaves, lime pellets, and coco coir. To determine the optimal composting conditions, the changes in temperature, pH, soil nutrient levels, and the rate the food is decomposed were measured. The bin with the level 6 amount of humidity decomposed the food the fastest and was the first bin to have no mold. This suggests that this level of humidity creates the best environment for the worms as they had the fastest rate of decomposition and had less mold which could potentially be harmful to the worms. With these results, better, more sustainable food waste management is possible.

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

Katrina Montano
Virginia Tech/Biological Sciences
Silvia Carbajal - Flores
Virginia Tech/Political Science
John Eagle
Virginia Tech/Political Science
Sanjay Karikal
Virginia Tech/Business Information Technology
Adya Muniganti
Virginia Tech/Political Science

The impact of High Deductible Health Plans on lower income populations

High Deductible Health Plans (HDHP) are insurance plans where you first pay a high cost of the medical care out of pocket and then slowly every medical visit you start paying smaller amounts until you reach the maximum out of pocket cost. The participants in our proposed study are low-income citizens that have either a HDHP or private insurance. The research proposed explores whether or not this affects the person's healthcare. Our research question is how do High-Deductible Health plans effect and impact the health care plans for lower income citizens? This proposed research includes a sample size of around 10,000 to 20,000 participants between the ages of 18 through 64 and have had a HDHP for at least 12 months. We expect to find that people with HDHP have lower health care and lower health as they forgo their medical plans because they can't afford the medication, procedure, or treatment. The motive behind this research is to find the negative and positive impacts and effects of HDHP and prevent low income citizens from making financial decisions that don't positively affect them. The research compares HDHP with private insurance and notices how different the health care plans compare regarding the health of the participants.

Mentor(s): Amanda MacDonald, University Libraries, Virginia Tech

Allison Montgomery
Virginia Tech/Ecological Restoration

Ligumia nasuta stress 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 Ligumia nasuta 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. A previous study we conducted showed that there was not a significant levels of stress response to Corbicula fluminea, an invasive bivalve. Due to this, we are investigating the physiological response of L. nasuta, a native bivalve, when exposed to TWRPs (5mg/L) and anti-inflammatory drugs (aspirin, ibuprofen, acetaminophen) (6.25mL each) in single and mixture exposure. Mussels undergoing a 48 & 96-hour acute exposure will evaluate glutathione levels (GSH) and superoxide dismutase levels (SOD) in mussels 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. As well as compare if a native species shows more stress than an invasive species.

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

Matthew Moore
Virginia Tech/Aerospace Engineering
Robert King
Virginia Tech/Aerospace Engineering

Machine Inference on Radio Signals for Space Domain Awareness

This project applies machine learning models to classify radio frequency (RF) signals. A novel, newly-developed dataset contains multiple signal types from multiple devices. The signals display as a waterfall plot, altering the power maximum and minimum as a form of data augmentation. Several image-based machine learning models train to identify the corresponding signal source and type. These results motivate deployment on satellites in proliferated, low-Earth orbit to provide real-time, automated space domain awareness.

Mentor(s): Brad Denby, Aerospace and Ocean Engineering (AOE), Virginia Tech

Miu Mottershead
Virginia Tech/Geoscience

Microplastic Particles and Sediment Grain Size in the Chesapeake Bay from the Early 20th Century to the Present

Microplastic pollution in estuarine ecosystems is a growing environmental concern due to its persistence and impact on both wildlife and human health, yet little is known about their distribution across different sediment sizes in marsh ecosystems. This study examines the relationships between microplastic abundance and grain size distribution in the Saxis Wildlife Management Area marsh and Wallops Island marsh, located along the Chesapeake Bay. Sediment cores were extracted from both locations and analyzed for grain size and microplastic particles. The results reveal how microplastic concentration varies with sediment grain size, with an emphasis on identifying which grain sizes are most associated with higher microplastic abundance. Additionally, the trends along the vertical profiles of the cores provide insight into the effects of historical human activities and sedimentary processes. The data revealed a general coarsening of sediment with depth, with finer sediments exhibiting higher concentrations of microplastics. This research contributes to understanding the relationship between sediment characteristics and microplastic retention in marsh environments, highlighting the role of sediment grain size in the transport and fate of pollutants in coastal systems.

Mentor(s): Tina Dura, Geoscience, Virginia Tech

Daniel Mounie
Virginia Tech/Psychology

Does Intensity Matter? Exploring the Role of Exercise and Technology Use in the Internalizing Symptoms of Adolescents with and without ADHD

Attention-deficit/hyperactivity disorder (ADHD) is a neurodevelopmental disorder characterized by inattention, overactivity, and impulsivity, and frequent comorbid anxiety and depression. Adolescents with ADHD exercise less and use more technology than their non-ADHD counterparts. The mental health benefits of exercise are increasingly being recognized, with intervention research indicating that individuals with ADHD may benefit more than those without ADHD. This study examined the relationship between exercise, technology use, and internalizing symptoms in adolescents from 8th through 10th grade. Participants included 302 adolescents (167 male; 247 white; Mage=13.17; 162 diagnosed with ADHD). Adolescents with ADHD reported exercising approximately half a day less/ week than their non-ADHD peers. Adolescents reported a significant increase in technology use from 8th to 10th grade (164 to 215 minutes), with adolescents with ADHD reporting using significantly more technology (8th: 45 minutes more; 10th: 75 minutes more). Similarly, the number of days adolescents reported engaging in exercise significantly decreased from 8th to 10th grade (0.3 days). Moderation analyses indicated that the benefit of exercise on reducing internalizing symptoms was stronger for non-ADHD adolescents than adolescents with ADHD in 8th grade. At 10th grade, no significant interactions emerged; instead, exercise significantly precited internalizing symptoms across adolescents. Surprisingly, technology use was unrelated to internalizing symptoms and the pattern of results was the same for 20 and 60-minute exercise sessions. Overall, results support efforts to increase the number of days adolescents engage with physical activity, and suggest that high intensity exercise may not be necessary to get the benefits of improved well-being.

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

Yiarely Munoz-Martinez
Virginia Tech/Civil Engineering

Vertiport Location Selection for UAM

Optimizing Vertiport Placement for Sustainable Urban Air Mobility in Houston

This research explores the integration of Urban Air Mobility (UAM) in Houston, focusing on optimizing vertiport placement and infrastructure to enhance urban transportation systems. The central research question investigates how strategic vertiport locations and their design can improve the efficiency, safety, and sustainability of electric vertical takeoff and landing (eVTOL) aircraft. The study aims to evaluate potential vertiport sites, assess traffic flow, and analyze the economic, societal, and environmental impacts of incorporating flying cars into urban environments.

The purpose of this research is to contribute to the growing field of UAM by identifying key factors influencing vertiport placement, such as accessibility, proximity to high-demand areas, and environmental considerations. This study fits into the broader context of sustainable transportation, offering a framework for addressing the challenges and opportunities of UAM integration.

To achieve this, the research employs advanced data analysis methods, including Geographic Information Systems (GIS), machine learning, and simulation-based optimization, to determine optimal vertiport locations. The study also incorporates noise mitigation strategies, such as rooftop vertiports, and accounts for environmental factors like wind patterns to ensure the sustainability of the UAM network.

Anticipated results suggest that strategically planned vertiports will significantly reduce travel times, alleviate congestion, and contribute to a more sustainable, integrated transportation system. The final outcome will be a comprehensive report that outlines recommendations for the practical implementation of UAM in urban environments.

Mentor(s): Sami Hasnine, The Charles E. Via, Jr. Department of Civil and Environmental Engineering, Virginia Tech

Rishi Nair
Virginia Tech/General Studies

Computational Modeling of a Bispecific Antibody

ABSTRACT
A solid tumor is an abnormal mass resulting from uncontrolled cell proliferation, commonly originating in breast, lung, or prostate tissues. The unique physiological characteristics of solid tumors present challenges for treatment using conventional methods. In solid tumors, the B7H4 receptor is frequently overexpressed on the surface of cancer cells, meaning the number of these receptors increases significantly. This overexpression makes B7H4 a crucial target for cancer diagnosis and targeted therapies. DuoBody is a bispecific antibody engineered to target two distinct receptors, enhancing therapeutic efficacy by facilitating T-cell-mediated cancer cell apoptosis. In this research, I focused on the B7H4 receptor, highly expressed in solid tumors, and the CD3e receptor, which plays a pivotal role in activating T-cell responses. I hypothesized that DuoBody antibodies targeting the B7H4 receptor on cancer cells and the CD3e receptor on T-cells could effectively induce CAR T-cell-mediated targeting of B7H4+ solid tumors. Computational modeling was performed to design DuoBody antibodies to test this hypothesis. The three-dimensional (3D) structures of the B7H4 and CD3e receptors were predicted using the AlphaFold 3 web server, while the 3D structures of antibodies were obtained from the Protein Data Bank. Molecular docking simulations were conducted using HDOCK2.0 to evaluate the binding interactions and affinities between the antibodies and their target receptors. The docking results were further validated using a graph neural network (GNN) framework. Antibodies were selected based on visual inspection, binding energy, and hydrogen bond interactions observed in the molecular docking simulations. Binding energy calculations using PRODIGY software revealed that antibody 4A6Y exhibited strong binding affinity to the CD3e receptor, while antibody 1IL1 1f8t showed robust binding to the B7H4 receptor. This research highlights the potential of DuoBody antibodies as a platform for pharmaceutical drug development, specifically for engineering bispecific antibodies targeting solid tumor cells and enhancing CAR T-cell-mediated immunotherapy.

Mentor(s): Katharine Davis, Blacksburg High School

CJ Nance
Virginia Tech/Psychology
Casey Kozan
Virginia Tech/Psychology
Pooja Yedavalli
Virginia Tech/Psychology
Gabe Townsend
Virginia Tech/Psychology

Transgender Psychological and Physical Safety at Virginia Tech: A Mixed-Methods Assessment

A place of psychological safety refers to a community or environmental setting wherein one feels included and able to take risks and contribute without fear of negative consequences. A physically safe environment is free from violence and threats of violence. Therefore, a sense of safety is essential for a person's well-being. Previous studies of transgender college students discovered alarming levels of transphobic harassment and discrimination–conditions that create psychologically and physically unsafe environments wherein students are unable to flourish.

According to its transgender student body, is Virginia Tech safe? If not, what dimensions of their safety most concern them? What can the administration do to be more supportive? The present study applied a 60-question self-report survey to assess the perceived psychological and physical safety of 29 trans students at Virginia Tech. 57 cisgender students took a similar questionnaire for comparison. Results have provided insight into where, at both a policy and community level, the university can improve in serving its transgender student body. As of Spring 2025, 19 survey sections displayed statistically significant differences in responses between trans and cis students. 84.6% of transgender respondents had been in a situation on campus where they felt threatened because of their gender presentation, compared with only 17.9% of cisgender respondents. Transgender participants felt less supported by and were less likely to access the Virginia Tech administration, and were more concerned about the behaviors of faculty, staff, and other students. This semester marks the beginning of qualitative interviews with TGNC respondents to gather more in-depth responses and further contextualize survey results; participants may also propose potential solutions to trans-specific issues.

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

Christina Navarro
Virginia Tech/Wildlife Conservation
Miles Dillah
Virginia Tech/Wildlife Conservation

Using camera traps to assess changes in flower visitation due to bird loss

Guåhan, one of several islands in the Marianas island chain, has become functionally birdless following the accidental introduction of the Brown Tree Snake (Boiga irregularis). Guåhan's ecosystem has become very different from its otherwise comparable sister islands, such as Saipan, upon which the Brown Tree Snake has not established. Guåhan's arthropod community has changed significantly in the absence of birds. Many birds and arthropods forage on flowers, pollinate flowers, or predate upon pollinators. We seek to understand how this trophic cascade has affected rates of flower visitation and pollination by comparing flower visitors between Guåhan and Saipan. Camera traps (Moultries and Wingscapes) were installed on both islands in June and July of 2024 to record visitors to 13 flowering plant species. Moultries were motion-activated and installed further from the plant than the Wingscapes to capture the larger visitors, while Wingscapes captured smaller visitors. We have completed a random subset of the first of two phases of manual camera trap footage review. Our most frequent visitors are ants, Papilionid and Nymphalid butterflies, European honey bees, and small flies. We have recorded two species of native birds, Canario and Nosa, visiting flowers on Saipan. We have also been able to identify which plants open their flowers at night, and which likely have their flower drop soon after it is pollinated. Future analysis will explore the time of day for visitors, and Phase II will more carefully examine the behavior of each visitor to distinguish likely pollinators.

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

Alyssa Nazigian
Virginia Tech/English Literature

The Indefinite Article & Language Change Over Time within Appalachian Speech

Appalachia is understood to be an under-investigated region for linguistics within the United States. Though studies have generally increased within the region overtime, even still, scholars note that certain unique features that have been observed have remained largely unexplored. It has been observed that within Appalachian English, when instances in speech occur where the indefinite article can be used ("a" or "an"), "a" is used more broadly than in Standard White American English. Looking at a set number of years, I used this feature to understand changes in the Appalachian dialect over time and what factors impact this. For my study, I looked into the rates of using the indefinite article variation of "a" (as opposed to "an") when preceding a word beginning with a vowel (e.g. "a apple") within Appalachian speech. I took data from 4 years (1974, 2001, 2010, 2015) from locations in central Appalachia (West Virginia & East Tennessee). There were approximately 680 instances of "an" or "a" recorded in a pre-vocalic position, and the speakers' gender, ethnicity, and age, as well as the year in which the interviews occurred were all noted. Based on known linguistic trends, the anticipated results include higher rates of "a" usage in younger speakers' speech, as opposed to the older age groups across each year, and a likely decrease in the usage of "a" in a prevocalic position over the selected years, with the highest rate occurring in 1974, and the lowest in 2015.

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

Evelyn Nelson-Pennebaker

Virginia Tech/Biochemistry

Discovering Chaperones and Investigating a Modification of Cofactor F430

Methane is both a potent greenhouse gas and a renewable source of energy. Since most methane on Earth is produced by methanogenic archaea, an understanding of the pathways they use for methanogenesis is vital for developing new strategies to reduce methane emissions as well as for bioenergy applications. The final, methane-producing step of methanogenesis is catalyzed by the enzyme methyl-coenzyme M reductase (Mcr), which uses a small molecule known as cofactor F430 to complete this step. The mechanism used to incorporate F430 into the Mcr active site is not fully known, but we hypothesize that a yet-to-be discovered chaperone protein is involved. Additionally, under some conditions, a modified version of F430 is produced that may modulate the activity of Mcr. This research aims to discover potential F430 chaperone proteins and to determine what conditions promote the production of modified F430. Potential chaperone proteins were explored using protein fractionation of cell lysates through anion exchange and hydrophobic interaction chromatography. Any F430 from these fractions was purified and analyzed with mass spectrometry. F430 was detected in several fractions that did not contain Mcr or free F430, which could indicate that there are F430 chaperones in those fractions. Further fractionation and purification of the putative chaperones will be pursued in future work. The modified F430, also detected through F430 purification and mass spectrometry, at first appeared to positively correlate with nickel concentration, but recently no modified F430 has been observed. To continue that aspect of research, it is necessary to determine what caused this halt in modified F430 detection.

Mentor(s): Kylie Allen, Biochemistry, Virginia Tech

Lacey Ngo
Virginia Tech/Biomedical Engineering

Detection of Canine Osteosarcoma Using Rametrix®Molecular Urinalysis

Osteosarcoma is quick-spreading and often fatal malignancy. Detecting and managing osteosarcoma is costly and inaccurate, and there are currently no assays or markers to detect pre-clinical disease or to evaluate disease progression. This work developed a Rametrix® Molecular Urinalysis (RMU) model for detecting canine osteosarcoma. Urine specimens from 89 healthy dogs, 53 dogs with lymphoma, and 43 dogs with osteosarcoma were scanned using precision Raman Spectroscopy of urine. The urine spectra were computationally and statistically analyzed and compared to the urine spectra of healthy individuals and other patients with disease. The preliminary results suggest that RMU can detect spectral fingerprints in the urine of dogs with osteosarcoma when compared to clinically healthy dogs and dogs with lymphoma. RMU was able to detect osteosarcoma with greater than 90% accuracy. The urine screening test is inexpensive, rapid, and minimally invasive. It could potentially be used in regular wellness screenings to improve early detection of cancer with more studies.

Mentor(s): John Robertson, Biomedical Engineering, Virginia Tech

William Ngo
Virginia Tech/Biochemistry

Investigating the Molecular Interactions of Soybean Lectins to Mitigate its Anti-nutritional Effects in Soybean Meal

Soybeans are an important food source for livestock and humans. This is due to its abundant nutritional properties. However, raw soybean must be processed before consumption due to anti-nutritional proteins, like lectin which binds to N-acetyl galactosamine (GalNAc) containing intestinal cells and inhibits nutrient absorption. Current soybean processing methods are relatively inefficient as processed soybean retains 20% of its anti-nutritional properties. This project aims to isolate and characterize lectin interactions with carbohydrates and lipids. The knowledge from these interactions would provide insights into ways to mitigate the effects of lectins in soybean meal more efficiently. Lectin was extracted from ground soybean meal through buffer extraction, affinity chromatography, and gel filtration, and identified through SDS-PAGE and mass spectrometry. Lectin affinities for carbohydrates and sulfatide were determined through isothermal titration calorimetry (ITC) and liposome binding assays/surface plasmon resonance (SPR), respectively. Lectin was successfully isolated and identified from soybean meal with a high purity. Lectin was found to bind strongest to GalNAc with a Kd of 62 μM among carbohydrates. However, lectin binds to sulfatides with a 1000-fold higher affinity in a membrane curvature dependent manner. GalNAc and sulfatide did not compete for lectin binding suggesting the presence of independent binding sites in the protein. The knowledge from these findings will be crucial in the design of additives (ligands) for soybean meal to serve as competitive inhibitors against GalNAc and sulfatides. These additives would prevent lectin from binding to GalNAc and sulfatides in the human or animal body, thereby mitigating lectin's anti-nutritional effects.

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

Minh Nguyen
Virginia Tech/General Studies

Optimizing Meta-Atoms for Large Scale Metalenses

Metalenses, promising new lightweight and customizable optical technology, are challenging to implement in practical situations. This is due to the difficulties of constructing precise, subwavelength-sized structures necessary for these lenses to function. Currently, metalenses are fabricated using methods such as e-beam lithography, which is too costly and time-consuming to apply on a large scale. Photolithography is a promising alternative method for efficient manufacturing; however, photolithography also has a lower resolution than current predominant fabrication technologies and depends on significantly larger meta-atom structures. This study addresses this issue by simulating several potential dielectric propagation phase-based metalenses using meta-atom structures optimized for their transmission intensity and maximal size. Four nanopillar shapes- circle, hexagon, triangle, and square- were investigated, and the resulting phase shift and transmission data were used to produce full phase coverage and incomplete phase coverage lenses. The study found that incomplete phase coverage lenses with small periodicity yielded greater focusing efficiencies while having larger minimum nanopillar radii when compared to complete phase coverage lenses with larger periods. Additionally, hexagonal and circular meta-atoms typically produced the best-performing metalenses out of the four shapes.

Mentor(s): Vinh Nguyen, Department of Physics, Virginia Tech
Katharine Davis, Blacksburg High School

Ngoc Thao Nhi Nguyen
Virginia Tech/Biochemistry
Jennifer Schneider
Virginia Tech/Biochemistry
Evelyn Kim
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Selin Mehmed
Virginia Tech/Biochemistry

Structural Impact of Glu157Leu Mutation on Glucokinase-Glucose Interaction

Glucokinase in E. coli is an enzyme that catalyzes the phosphorylation of glucose. In humans, glucokinase plays a critical role in regulating insulin release, and improper regulation can lead to elevated blood sugar levels, increasing the risk of type 2 diabetes. Along these lines, a mutation near the glucose-binding site could significantly impact the protein's functionality and its role in insulin regulation. The residue glutamate-157 is a key interaction point within the glucose-binding site, which led to the hypothesis that mutating glutamate-157 to an amino acid with opposite chemical properties, such as leucine, would reduce the functionality of glucokinase. To test this hypothesis, glutamate-157 was mutated to leucine using molecular visualization, and molecular docking simulations were conducted to analyze the effects on glucose binding. The docking results indicated that glucose had a greater interaction distance from the mutated Leu-157 residue. This change was associated with a decrease in predicted interaction strength between glucose and the mutated glucose-binding pocket. These findings support the idea that substitutions at this site can impair glucokinase function. Investigating these interactions is essential, as mutations affecting glucokinase may reduce insulin secretion and contribute to an increased risk of type 2 diabetes.

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

Alexandra Ni
Virginia Tech/General Studies

Machine Learning-Driven Analysis of Temperature and Proximity Effects on Landfill Greenhouse Gas Emissions

This study explores the impact of temperature and distance from landfills on carbon dioxide (CO_2) and methane (CH_4) concentrations in surrounding soil. Landfills are a significant source of greenhouse gas emissions, contributing to climate change and global warming. Understanding how proximity to landfills and environmental variability influence greenhouse gas levels is essential for developing effective waste management policies and mitigating environmental impacts. In this study, CO_2 and CH_4 concentrations were measured at varying distances from several landfill sites and across different temperature conditions. A multiple regression analysis performed on the collected data identified statistically significant relationships between distance, temperature, and CO_2 levels (p-value < 0.05, $R = 0.774$). Every CH_4 measurement was less than the lower limit of detection of the gas detector, so no statistical evaluations were performed on those data points. To improve predictive performance, several machine learning (ML) models were employed: random forest regression, support vector regression, and neural networks provided enhanced insights into nonlinear interactions between temperature, distance, and CO_2 concentrations. Additionally, an unsupervised clustering approach (k-means and hierarchical clustering) was applied to classify sites based on gas emission patterns, allowing for a more refined understanding of landfill-related environmental risks. The integration of machine learning methodologies enabled the development of a data-driven predictive model, which can enhance policymaking, risk assessment, and the implementation of sustainable waste management strategies. The proposed ML-based framework provided a scalable and adaptable tool for analyzing landfill emissions, supporting future studies in environmental monitoring and greenhouse gas mitigation efforts.

Mentor(s): Jared Brown, Southwest Virginia Governor's School
Katharine Davis, Blacksburg High School

Olivia Nyarko-Odoom

Virginia Tech/Human Nutrition, Foods, and Exercise

Dietary Completeness Coding for Home-Prepared Dog Diets

This research project investigates the nutritional completeness of dog diets within the Dog Aging Project. In this cross-sectional study, our research aims were to explore whether dogs across the country were receiving adequate nutritional requirements from the diets fed to them by their owners. Food diaries were acquired from 1,726 dog owners in which either home-prepared meals or commercial kibble was fed to their companion dog. After assessing which type of meal was given, we utilized a website designed by veterinary nutritionists that allows one to code dietary components and identify nutritional deficiencies. Finally, if the diet had greater than or equal to 10, less than 10, or zero deficiencies, we labeled each entry as incomplete, partially complete, or complete based on The Association of American Feed Control Officials (AAFCO) criteria. Out of the 1,726 home-prepared diets, 341 (20%) had insufficient ingredient information to code dietary completeness, 751 (44%) were classified as incomplete, 527 (31%) were partially complete, and 107 (6%) were complete. Overall, a large majority of dog diets did not meet nutritional needs. These results indicate that further research is necessary to understand the potential health outcomes of nutrient deficiencies in companion dogs.

Mentor(s): Audrey Ruple, Department of Population Health Sciences VA-MD College of Veterinary Medicine, Virginia Tech

Janice O'Brien, VA-MD College of Veterinary Medicine, Virginia Tech

Leela Ohri
Virginia Tech/Biochemistry

Genomic evidence for adaptive evolution of Salmonella Typhimurium

Salmonella Typhimurium, a significant foodborne pathogen, has a known capacity to infect a broad host range. However, the mechanisms to genetically adapt to different hosts are underexplored. Here, we performed pangenome analysis of 745 S. Typhimurium genomes representing five isolation sources, including bovine, swine, poultry, wild birds, and the environment, to uncover genome variants driving adaptive evolution in different hosts. S. Typhimurium showed large genomic variance across different isolation sources, supported by source-associated subclades based on single nucleotide polymorphisms (SNPs) and differences in the pangenome size and openness and prevalence of plasmids, prophages, and antibiotic resistance genes (ARGs). Of note, S. Typhimurium from swine exhibited the largest and most open pangenome, and the highest prevalence of ARGs, likely mediated by horizontal gene transfer via transduction. While positive selection acting on core genes was not as strong as accessory genes, its frequency among core genes significantly varied across isolation sources. S. Typhimurium from the environment was found to undergo strongest positive selection, particularly acting on genes encoding cell cycle control and coenzyme and nucleotide transport and metabolism. Using machine learning (ML), we further showed that isolation sources were predicted by gene presence/absence and SNPs with high accuracy (mean auROC of 0.98 for both). These findings indicate that S. Typhimurium undergoes adaptive evolution when exposed to different hosts and environmental conditions, with the pangenome fluidity enabling a broad host range. Such fluidity also enables accurate prediction of sources using ML, supporting efficient source tracking of foodborne pathogens and enhancing food safety decision-making.

Mentor(s): Jingqiu Liao, Civil and Environmental Engineering, Virginia Tech

Kathryn Ouimet
Virginia Tech/Biological Sciences

The Effectiveness of at Home Water Filters at Removing PFAS and Camping Straws at Removing Microplastics.

Over the past years, the concentration of PFAS and microplastics found in freshwater ways has been increasing steadily and are showing to have adverse effects on human health. Modern day solutions such as at home water filters claiming to remove PFAS and camping straws claiming to remove microplastics have entered the market as possible solutions to these problems. However, these claims being promised to consumers may not to true. The goal of this project is to determine if at home water filters remove legacy PFAS by spiking water with known concentrations of PFAS and passing the solution through the filter over its tested 65 gallon insurance of PFAS free water. The next part of the project is to determine if camping straws marketed for the consumer to be able to drink directly out of the freshwater systems and trap them before they enter the consumer. Water will be spiked with microplastics (fibers) at a known concentration (5 mg/L) and placed under vacuum filtration to move solution through the straw. We will measure how many particles are retained in the solution that passes through the straw to determine removal efficiency over the study (life span of the straw). As mentioned above, the long-term effects of microplastics and PFAS to human health are still unknown. However, microplastics and PFAS are contaminants that will be forever present in our environment. This project aims to draw attention to these issues and potential false advertising to consumers.

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

Anjali Pamulapati
Virginia Tech/Systems Biology

Assessment of Ticks Sampled from Hunted Deer in Southwestern Virginia for Powassan

Powassan virus (POWV) is a tick-borne flavivirus first described in Ontario, Canada in 1958 with distribution in North America and Russia and rising prevalence in the United States. Limited information exists on POWV circulation in Virginia outside of serological evidence in wildlife. POWV symptoms in humans range from fever and vomiting to encephalitis and meningitis. With a fatality rate of 10% and high likelihood of long-term sequelae, it is imperative to monitor POWV's prevalence. POWV is primarily transmitted by three tick species: Ixodes scapularis, Ixodes cookei, and Ixodes marxi; however, it has also been isolated from Dermacentor andersoni. Both I. scapularis and D. andersoni feed on humans and thus pose public health concerns, while all the aforementioned ticks (in addition to other species) feed on white-tailed deer (Odocoileus virginianus). This study will examine POWV prevalence in ticks opportunistically sampled from hunted white-tailed deer brought to Chronic Wasting Disease check stations across Southwestern Virginia in 2021 and 2024. Ticks were maintained on a cold chain and stored at -80°C, enabling viral preservation. DNA and RNA will be dual extracted from the ticks for POWV detection using RT-PCR; a follow-on project will use the DNA to examine prevalence of Borrelia burgdorferi (the causative agent of Lyme disease). The study is expected to reveal patterns in POWV persistence in Virginia. While prevalence among samples is expected to be low due to Virginia's few clinical cases, assessing POWV presence in ticks found on deer is critical for monitoring its spread and anticipating human infection trends.

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

Derek Pantel
Virginia Tech/Biological Sciences: EEB

Microbiome Community Composition Effect On Hard Cider Phenolic Profiles

Terroir is a component of hard cider that combines environmental factors and human practices to form distinctly unique finished products. The purpose of this study is to observe how environmental factors of location, cultivar, and microbial communities affect flavor profiles of hard cider.
To perform this, we fermented two apple cultivars using varied additions of commercial yeast and sulfites over 160 replicates. We harvested apple skin and pulp samples and extracted phenolics from the tissue samples. Phenolics were analyzed with High Performance Liquid Chromatography (HPLC) and compared to known standards of 14 prevalent phenolic compounds identified in previous studies.
We predict that varied microbial communities affect phenolic composition and therefore, flavor because terroir is known to vary with location and climate. If microbial communities are the main contributor to terroir, we expect the variance of phenolic composition and terroir to be greatest in wild fermented cider, intermediate in the addition of commercial yeast or sulfites, and minimal in the addition of sulfites and commercial yeast.

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

Andrew Parker
Virginia Tech/Biology
Anukrit Shahi
Virginia Tech/Microbiology
Ishan Pandya
Virginia Tech/Biology
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Virginia Tech/Chemistry
Alfred Viyuoh
Virginia Tech/Biology

Effects of Point Mutations on the MET 370 Amino Acid of the Oxytocin Receptor

Oxytocin is one of the 7 main human hormones, and is the main contributing hormone involved in social interactions. Mutations in the oxytocin receptor (OTR) have been linked to difficulties in socializing. The proper bonding of oxytocin to its receptor is vital to social bonds, proper social behaviors, and relationship building. The bonding of oxytocin to OTR at the amino acid MET 370 was observed and point mutations were performed on the amino acid. The bond distance between the ligand and the unaltered amino acid was measured to be used as a control. MET 370 was mutated multiple times, and the bond distance was measured each time. The values were compared to the control, and it was found that when the methionine was mutated into isoleucine, leucine and valine, no hydrogen bond formed. A mutation into threonine resulted in a longer bonding distance, which indicates a smaller binding affinity and a weaker bond. This could result in difficulty socializing and making connections. Mutations into lysine and arginine resulted in smaller bond distances and therefore a stronger bond, which has been connected to difficulty in regulating emotions. Future research in the field of drug design can be performed to discover methods of strengthening or weakening this bond to ensure normal binding of oxytocin to its receptor.

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

Kajal Patel
Virginia Tech/Computer Science

Advancing Scene Graph Generation with Open-Vocabulary Models

Scene Graph Generation (SGG) is a critical task in computer vision, aiming to model objects and their relationships within an image. However, traditional SGG models rely on predefined, closed vocabularies, limiting their ability to generalize and recognize rare or novel entities. This research seeks to overcome these constraints by integrating a Large Vision-Language Model (LVLM) and query transformers architecture to enhance both object and relation prediction.

The purpose of this study is to improve the adaptability and robustness of SGG models, enabling more accurate recognition of uncommon objects and relationships. By addressing biases toward frequently encountered entities, this work contributes to broader applications in areas such as Visual Question Answering, robotics, and autonomous systems, where dynamic scene understanding is essential.

The methodology involves leveraging QFormer for flexible and contextualized query embeddings while utilizing Hungarian matching for optimized assignment of detected objects and relationships. Additionally, zero-/few-shot learning techniques are incorporated to enhance generalization beyond the training set. Performance will be evaluated through ablation studies, benchmarking on long-tail distributions, and comparative analysis against existing SGG models.

We anticipate that this approach will lead to improvements in both object and relation prediction, particularly for rare categories, demonstrating the potential for more generalized and scalable scene understanding. Future work will focus on refining relation prediction mechanisms and further optimizing model architecture to push the boundaries of SGG performance.

Mentor(s): Ismini Lourentzou, Information Science, Virginia Tech

Emily Paul
Virginia Tech/General Studies

The Effects of Heavy Metal Contaminants on Negative Phototropism Behaviors in Ephemeroptera Species

The Radford Army Ammunitions Plant (RAAP) is a supplier of propellants and explosives that is located on the New River, a significant water source and recreational area in Montgomery County, VA. Environmental monitoring of the RAAP measured several heavy metal contaminants in soil that exceeded established regulation, which can run off into the New River and accumulate. Freshwater macroinvertebrates at low trophic levels, such as Ephemeroptera (mayflies), are sensitive to environmental changes due to their variety of feeding habits, rapid metabolism, and hemimetabolous life cycles. This study investigated Heptageniidae, a common mayfly scraper, that feeds on algae where contaminants may have accumulated from upstream (Radford, VA, n = 20) and downstream (Parrott, VA, n = 42) locations of the RAAP. Water samples (n = 6) were collected and analyzed for metal ion content using Inductively Coupled Plasma Mass Spectrometry (ICP-MS), revealing significantly increased concentrations of magnesium, calcium, sulfur, and strontium downstream (p-value < 0.001 to 0.04) that were within the United States Environmental Protection Agency's regulatory limits. Negative phototropism was then tested on collected mayflies by using green light and measuring net distance traveled along the light intensity gradient in shallow water where sampling location was not a significant factor (p-value = 0.066). The length and mass of the mayflies were measured and showed that mayflies from upstream were significantly (p-value < 0.001) less massive per length and power series regression constants were found. The study failed to reject some parts of the alternative hypothesis due to significant p-values, but showed significant disturbance to the biomass, which can reasonably be correlated to increased metals downstream of RAAP.

Mentor(s): Sally Entrekin, Aquatic Entomology, Virginia Tech
Lisa Tabor, Aquatic Entomology, Virginia Tech

Sarah Paz
Virginia Tech/Civil Engineering

An empirical analysis of the levee effect

The levee effect occurs when flood risk in the long run is increased due to the construction of levees. Levees mitigate floods; however, they lead to a decreased perception of risk and further development in the area protected behind the levee. The community is more vulnerable when the levee is overtopped, and the flooding events cause more destruction. Existing research primarily uses empirical data and case studies to demonstrate the levee effect in specific locations; theory-driven models establish the feedback loop between society and bodies of water. Recent research demonstrates the levee effect by linking levee construction with increased development of urban floodplains. The objective of this research is to empirically analyze the levee effect throughout the United States by demonstrating the theory-driven feedback loop between flood risk, development, and levee construction. The guiding hypotheses are that levees cause an increase in development, subsequently increasing flood risk and leading to further levee construction. Additionally, the development and risk exceed their value prior to the levee or the value that they would have taken had it not been for the levee. Using the National Levee Database, this study will empirically examine the levee effect across the United States through data driven analysis and different econometric and machine learning models.

Mentor(s): Landon Marston, Civil Engineering, Virginia Tech

Kilee Pearson
Virginia Tech/Psychology

Investigating the impact of alexithymia on empathy in schizotypy and autistic traits; a community sample replication study

Alexithymia is mainly characterized by difficulty identifying and describing one's emotions and feelings. This study sought to replicate previous research investigating alexithymia and empathy related to schizotypal and autistic traits in community samples. Our goal was twofold: to examine the cross-cultural validity of these findings, and to expand the analysis by accounting for sex differences. Our sample consisted of young adults who were native German speakers from Salzburg, Austria. Using similar methodologies, we partially replicated previous results as well as found that those results remained significant when controlling for sex differences. Specifically, we confirmed previously reported negative correlations between alexithymia and schizotypal and autistic traits. Similarly, we partially confirmed a significant indirect effect of alexithymia on the relationship between schizotypal traits and empathy, as well as the absence of this relationship when accounting for alexithymia. We also replicated a significant indirect effect of alexithymia on the relationship between autistic traits and empathy, and this remained significant after accounting for alexithymia.
There are several reasons why our replication may not have been entirely successful. First, although we used the same assessment tools as previous studies (i.e., The Toronto Alexithymia Scale, The Autism Quotient, and the Schizotypal Personality Questionnaire/SPQ), cultural differences may have played a role. Another reason could be due to measurement differences in empathy; previous studies used the Interpersonal Reactivity Index, while we used the Empathy Quotient for Adults. Lastly, there are different ways in which the SPQ can be scored, and this may also have influenced the replicability.

Mentor(s): Lavinia Carmen Uscatescu, Psychology, Virginia Tech

Marquesa Peloquin
Virginia Tech/APSC

How Accurately Do Owners Remember What They Feed Their Dogs?

How Accurately Do Owners Remember What They Feed Their Dogs? The purpose of this study is to evaluate the accuracy of owner-reported dog diets, specifically focusing on individual ingredients. Given the increasing trend of dog owners preparing meals for their pets, this research aims to validate the data collected from owners about the composition of their dogs' meals and determine how accurately these reports reflect the actual ingredients used. The study employed a cross-sectional design, where a sample of roughly 1,200 dog owners who participate in the Dog Aging Project were surveyed about their pets' daily diets in 2024. Owners provided detailed information regarding the ingredients used in the preparation of their dogs’ meals throughout a 3-day period. Statistical analyses, including correlation and regression tests, were applied to compare the reported data against actual ingredients to measure accuracy. Owners demonstrated high accuracy in reporting protein, fruit, dairy, and fat content in their dogs’ diets, but were less consistent with vegetables and unreliable for carbohydrates. Inaccurate reporting of ingredients could lead to nutritional imbalances, notably when essential nutrients are inaccurately accounted for. These findings highlight the need for improved dietary tracking tools or education for owners, particularly for complex categories like carbs and mixed vegetables.

Mentor(s): Aurdrey Ruple, DVM, MS, PhD, DipACVPM, MRCVS, FNAP Dorothy A. and Richard G. Metcalf Professor of Veterinary Medical Informatics Program Director of the Biomedical and Veterinary Sciences Graduate Program
Virginia-Maryland College of Veterinary Medicine, Virginia Tech
Janice O'Brien PhD Student, Population Health Sciences Dept
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Vivian Peou
Virginia Tech/Biochemistry
Sara Al Mutawalli
Virginia Tech/Biochemistry
Charlotte Clodfelter
Virginia Tech/Biochemistry
Zachary Glienke
Virginia Tech/BioChemistry

Modeling the Effect of a GLY-1099 Mutation in ATP7B on ATP Binding: Implications for Wilson's Disease

Copper binding proteins are critical in air-breathing organisms for facilitating oxygen transport and electron transfer. ATP7B is a copper-transporting ATPase involved in regulating intracellular copper levels. It is essential for cuproenzyme metalating and the maintenance of copper homeostasis. Specifically, the GLY-1099 residue is one of the key residues that contribute to ATP binding. A mutation of GLY-1099 to proline is predicted to reduce the binding affinity of ATP to the copper-transporting domain. This study investigates how this mutation affects the ATP binding affinity of ATP7B. GLY-1099 was mutated to PRO-1099, and molecular docking was used to evaluate the impact of this mutation on ATP binding. Both wild-type and mutant protein structure were uploaded to visualization software for comparative analysis. The uploaded ligand exhibited a bent binding orientation, and several predicted interacting with the active site were absent. These observed differences suggest a decrease in ATP binding efficiency. Understanding how mutations in the ATP7B protein affect ATP binding affinity may help elucidate the molecular mechanisms underlying Wilson's disease—a disorder caused by ATP7B malfunction leading to copper accumulation in organs. This knowledge could inform the development of therapeutic strategies aimed at restoring proper copper regulation. Therefore, further investigation of ATP7B mutations—especially substitution that induced more pronounced structural changes at the binding site—may provide valuable insights into protein-ligand interactions and guide future drug development.

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

Joseph Pettinger
Virginia Tech/Psychology
Briana Ermanni
Virginia Tech/Psychology (grad student)

Longitudinal relations between inhibitory control performance and baseline and task Respiratory Sinus Arrhythmia

Respiratory Sinus Arrhythmia (RSA) is a physiological marker of self-regulation and can positively influence cognitive functions like inhibitory control (IC) (Booker & Buss, 2010). RSA can be measured at rest (i.e., baseline RSA) and during a cognitive or behavioral task. Baseline RSA is considered a trait-like response to a child's environment and task RSA can reflect contextual demands (Utendale et al., 2013). The current study assessed how strongly baseline RSA and task RSA are related to developing IC at 24-months, 36-months, and 48-months. In a sample of 240 children, baseline RSA was collected at each age while children watched a short clip of Finding Nemo. To assess task RSA and IC performance at 24-months, RSA was collected during the Shape Stroop task, where children needed to point to a smaller fruit shape embedded within a larger and different fruit shape, and vice versa. To observe task RSA and IC performance at 36-months and 48-months, RSA was collected during a different developmentally appropriate IC task: in the Day/Night task (Gerstadt et al., 1994), children are shown pictures of a sun or moon and are asked to say the opposite time of day (e.g., say "day" for a moon). These tasks were used to quantify IC because they require concentration and mental exertion to employ regulation. Correlation analyses suggest baseline RSA is not related to performance on inhibition tasks over time, whereas task RSA is a better metric of physiological regulation at ages 3 and 4, but in different directions.

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

Chloe "Leo" Phelps
Virginia Tech/Biological Sciences

The Bored Broiler Project

Commercial broiler chickens are raised in barren environments that may fail to meet the birds' motivation for novelty, causing boredom. This trial tested two novel methods for boredom assessment. Ross 708 broilers (n=144) were raised in barren (commercial-like) or complex (enriched) pens. We observed behavior (active, inactive, resting; sit/stand) for six days, twice daily between d14-20. Between d21-29, we provided objects of positive, neutral, or negative valence for 12h, with 48h wash-out. Birds' latencies to approach objects were recorded. GLMMs were used with treatment as predictor and pen, room, and date/time as random effects. Barren pens had more inactive standing than complex pens (3.9±0.3% of observations vs 2.5±1.7%, $p=0.031$), indicating more boredom. Other behaviors did not differ. Latencies to enter within 5 bird-lengths of the positive (4.9±0.03 min) and neutral (2.5±0.03 min) object were shorter than for the negative object (56.7±0.03 min; $p<0.001$), but did not differ between treatments ($p>0.5$), suggesting that this test did not detect differences in boredom. This pattern persisted for latencies to 1 bird-length from items (positive: 53.6±0.03 min; neutral: 4.7±0.03 min; negative: 251.2±0.03 min; $p<0.001$). Differences between objects indicate applicability for assessing broilers' motivation for novelty. Behavior may be more sensitive to boredom than object approach. This trial may have resulted in little boredom due to ample pen space and young age of birds.

Mentor(s): Leonie Jacobs, CALS, Virginia Tech

Lyra Piche
Virginia Tech/General Studies

English Place-Names and Viking Activity

The time period 795-1066AD contained an abundance of Viking incursions and raids into Britain. These incursions had a large effect on the developing country of England, in a cultural, linguistic, and genetic manner. The linguistic effect is most present in place-names; many place-names in England have Old Norse elements, most of which are thought to derive from Viking invasions. If the correlation between Old Norse-element place-names and Viking activity is strong enough to merit accurate identification of Viking archaeological sites, it can simplify the search for sites of battles or Viking activity whose locations are presently unknown. This study seeks to discover whether Viking-element place-names are correlated strongly enough with sites of proven Viking activity to allow for accurate or near accurate identification of Viking sites for future archaeological research prior to any actual archaeological research. The data collected from the Gazetteer of British Place-Names, the Key to English Place Names, the Anglo-Saxon Chronicle, and Archi Maps UK appears to prove that this correlation is not strong enough to merit use. 18 of 31, or 58%, of the historic counties with Old Norse-element place-names had no Viking sites within 10 kilometers of any of the Old Norse-element sites, and of the 39 historic counties examined in this study, only two had percentages of names with both Old Norse elements and Viking activity over 50%.

Mentor(s): Katharine Davis, Blacksburg High School

Benjamin Pittelkau
Virginia Tech/Photonics

Advancing continuous real-time nanoplasmonic Raman biosensing via acoustic in-line sensor surface cleaning

Surface-enhanced Raman spectroscopy (SERS) offers exceptional molecular sensitivity for trace analyte detection across biomedical, environmental, and agricultural domains. However, long-term SERS operation is hindered by sensor fouling from molecular contaminants and biofilms, which compromise signal fidelity. Here, we present an acoustic antifouling strategy that enables long-term SERS biosensing by integrating a piezoelectric transducer-based cleaning mechanism with nanolaminate nanoplasmonic substrates. We investigate whether acoustic actuation can (1) effectively remove foulants from SERS surfaces, (2) preserve sensor sensitivity after repeated cleaning cycles, and (3) be incorporated into a closed-loop monitoring system for sustained in situ detection. Our approach employs a lead zirconate titanate (PZT) transducer driven by radiofrequency signals to generate resonant acoustic waves to dislodge adsorbed contaminants without damaging the SERS substrate. Cleaning performance is evaluated using a confocal Raman microscope by comparing spectral signals before and after actuation. In a static petri dish model, acoustic cleaning reduced the SERS signal of Rhodamine 6G (R6G) foulants by 84% within 20 minutes. Long-term testing over 95 minutes with a two-component system of R6G (analyte) and human blood serum (foulant) showed strong analyte signal when the SERS sensor was treated with a passive antifouling coating (L-Cysteine) and acoustic actuation. Preliminary integration into a flow cell suggests the potential for closed-loop SERS monitoring under continuous flow conditions. These findings establish a foundation for stable, long-lasting SERS platforms capable of real-time chemical sensing in challenging matrices.

Mentor(s): Wei Zhou, Electrical and Computer Engineering, Virginia Tech

Nolan Platt
Virginia Tech/Computer Science
Ethan Luchs
Virginia Tech/Computer Science

LLM-Driven Heuristic Evaluations of Code Snippets

Many studies in Human-Computer Interaction (HCI) have underlined the importance of usability evaluations to ensure that applications will meet their intended purposes across a broad range of users. In recent years, software and technology have been shown to be one of the most important aspects of daily life. Our growing dependence on technology to guide our lives has led to a growing discussion of usability concerns, with specific regard to accessibility barriers, responsiveness issues, and potential interaction challenges. Typically, the usability of an application is assessed through a human's heuristic evaluation of the design, relying heavily on an individual's knowledge of heuristic evaluation methods and skills. In this paper, we will explore how integrating Large Language Models (LLMs) with Nielsen's heuristic evaluation principles could potentially allow design flaws to be spotted at the development stage. As software development continues to grow, it is critical that we identify design flaws in code before interfaces are fully developed. We would seek to understand the use of LLMs in early-stage usability evaluations, potentially allowing critical design flaws to be spotted at the programming and development level. Typically, design flaws cannot be easily spotted until an application is somewhat developed, causing significant time spent spotting and correcting the flaws well after development. Our research would center around analyzing open-source, widely available websites and infrastructures that are posted on GitHub and similar code-sharing websites. There is an ethical dilemma in analyzing code of websites and applications that are not expressively open-source. Thus, conducting our studies of open-source websites and applications will ensure that we are taking the most ethical route in our research. Our research would also center on how well different LLMs perform on the aforementioned usability evaluations. We can compare performance of the newly released OpenAI o3-mini-high versus previous models, such as o1 and o1-mini. Further, we can also examine how those three perform against competitors, such as DeepSeek-R1. We would also examine how existing open-source LLMs can be improved to more precisely identify usability flaws at the design level. Using all of this data, we could perform null-hypothesis testing and draw conclusions on how well various LLMs perform on usability evaluations. Specifically, the p-value between results of different LLM models and actual human participants will help us make various conclusions about the usage of AI-driven heuristic evaluations at the development level. If design flaws can be detected early, software engineers and usability evaluators would save significant time and energy while developing applications. In short, we could potentially uncover a new, historically significant research area in Human Computer Interaction (HCI).

Mentor(s): Sehrish Nizamani, Computer Science, Virginia Tech

Jackson Pollyea
Virginia Tech/General Studies

The Effect of Sleep Quality on the Power Output of Youth Cyclists

Over the last decade, youth cycling has seen a tremendous increase in popularity with the rise of organizations such as the National Interscholastic Cycling Association (NICA) which makes way for the new generation of student-athlete cyclists nationwide. As a sport that places substantial importance on both aerobic endurance and anaerobic sprint efforts, sleep is of paramount importance for optimizing performance. The relationship between sleep quality and performance in youth cyclists is more substantial than many realize, as student-athletes deal with both training and academic demands that may impair performance. While prior studies have shown the impact of sleep quantity and quality on perceived exertion, heart rate, and minimizing risk within the sport of cycling, establishing the momentousness of sleep on the sport can be more accurately measured in examining its effect on power output. This study set out to identify how changes in sleep quality over two weeks affect the normalized power output of youth cyclists. The findings suggest that sleep quality does indeed have somewhat of an effect on the power output of youth cyclists to a certain degree. It supports the existing idea that 7-9 hours of shuteye sleep is ideal in maximizing performance, with participants reporting more experiencing a decrease in power output over the two-week period. More research must be done to fully identify the effects of sleep within different disciplines of cycling, and in both aerobic and anaerobic efforts.

Mentor(s): Katharine Davis, Blacksburg High School
Karen Talley-Mead, Spicychickpeacoaching/Cardinal Bike Shop

Ida Polys

Virginia Tech/General Studies

Gauging the Cultural Relevance of Bluegrass Lyrics to Central Appalachia via Linguistic Analysis

A social practice and a sonic one, Bluegrass music is defined by ballads, gospels, and square dances with traditional lyricism. Despite its integral role in Appalachian society, the greater influence of Bluegrass is frequently overlooked by Americans due to a lack of education about its region of origin. This project focuses on empirically defining the ties between Bluegrass lyrics and elements of politics, geography, and culture that are specific to Central Appalachia to highlight the culture's impact on its art forms. Through previous research in Appalachian Studies, we can identify how communities have used Bluegrass music to gather together and share experiences throughout history. By identifying linguistic patterns that denote culture, this project aimed to find a demonstrable relationship between Bluegrass songs and the cultural conventions of Central Appalachia, a relationship that, in the past, has largely only been observed through pathways of oral tradition. A randomly sampled catalog of 1,770 Bluegrass "standard" songs was assembled via BluegrassLyrics.com, and keywords denoting cultural significance in Appalachian society were analyzed for frequency. The hypothesis that Bluegrass carries significant specificity to Central Appalachian culture was ultimately supported, with data finding that there were notable presences of multiple culturally relevant themes such as religion, family, nature, and regional dialect in the catalog. These findings may contribute to a deeper understanding of and compassion toward Appalachian culture and its artistic capacity for those without knowledge of the area.

Mentor(s): Katharine Davis, Blacksburg High School

Jacob Porzeinski
Virginia Tech/APSC

Are responses to feeding low dietary amino acids conserved across mammalian and avian species?

Recent research in mammalian nutrition has suggested that dairy cattle, ruminant livestock, and mice may respond to single additions of non-limiting amino acid supplementation. Dairy cattle resulted in increased milk production and mice increased offspring weight and direct body weight gain (Apelo et al., 2014; Liu et al., 2017). Based on these mammalian responses, the effects of reduced crude protein (CP) with single AA supplementation were determined using early growth performance in fast-growing broiler chicks. Two experiments were completed with broilers over 0 to 14 days. Experiment 1 included a positive control (100% CP), a low protein negative control (70% CP), and the same 70% diet with seven individual AA treatments: Lys, Met, Thr, Ile, Trp, Val, and non-essential AAs (NEAA). These 9 diets were fed to 17 replicate cages of 5 birds per treatment. The second experiment consisted of PC (100% CP), NC (80% CP or moderately low), and five AA treatments (Lys, Leu, His, NEAA) fed to 13 replicate cages of 5 birds each. Unlike both dairy cattle and mice, the broiler chicks did not respond to single AA additions to either low or moderately low dietary CP, suggesting differences among the responses based on species. Potential differences that could explain these results include the fact that chicken have been selected for increased growth, whereas mice have not. Additionally, dairy cattle performance is mediated by the mammary gland rather than direct muscle growth.

Mentor(s): Michael Persia, APSC
Mark Hanigan, DASC, Virginia Tech

Jaya Powell
Virginia Tech/Psychology

Relations between Parental Psychological Control and College Students' Emotional, Public, and Altruistic Prosocial Behaviors

Prosocial behaviors are voluntary acts intended to benefit others, such as sharing and helping (Carlo, 2006). Individuals engage in different types of prosocial behaviors based on their motivation: (a) altruistic refers to actions primarily intended to benefit others without expecting anything in return and is driven by internalized moral values; (b) public refers to actions displayed in the presence of an audience, motivated by gaining recognition or receiving acknowledgement; and (c) emotional refers to actions driven by empathy and displayed in emotional situations. Parents use various parenting behaviors to socialize their children's prosocial actions. One example is psychological control – parents control their children's thoughts and feelings, operationalized as manipulative parenting practice, including love withdrawal and guilt induction (Barber, 1996). When parents use psychological control strategies, children may feel that their thoughts must align with those of their parents, reducing the sense of autonomy. Thus, parental psychological control might be negatively related to children's prosocial behavior (Fu, 2022). However, little is known about these relations among college students. The present study examines how parental psychological control relates to public, emotional, and altruistic prosocial behavior among 807 college students (Mage = 19.1, SD = 1.21, 63.3% female, 79.6% White). Regression analyses revealed that parental psychological control was positively associated with public and emotional, while it was negatively associated with altruistic prosocial behavior. However, after controlling the effects of gender, the relation between parental psychological control and emotional prosocial behavior became non-significant. Overall, these results suggest that parental psychological control is linked to college students showing more prosocial behaviors in public but fewer altruistic behaviors toward others.

Mentor(s): Zehra Gulseven, Psychology, Virginia Tech

Athithi Prakash
Virginia Tech/General Studies

Novel Engineered Anticancer Biomaterial for Non-Invasive Melanoma Treatment

Skin cancer is the most commonly diagnosed cancer in the United States. Melanoma causes the majority of skin cancer related deaths. Current melanoma treatment options of surgery and immunotherapy are invasive and have low response rates. This study develops a novel topical melanoma treatment by engineering temporin-1CEa, an anticancer peptide (ACP), into the C-terminal of CsgA (a nanofiber base unit) for localized drug delivery to address current treatment limitations. While temporin-1CEa is specific and highly toxic to cancer cells, its systemic administration leads to off-target effects. Nanofibers provide support and allow topical application of the peptide, leading to localized, controlled treatment. The hypothesis tested was that the peptide-nanofiber complex would retain temporin-1CEa's anticancer activity while exhibiting cytotoxicity comparable to that of 5-fluorouracil (5-FU), the current standard topical treatment for skin cancer. This was evaluated via multiple LDH (Lactate dehydrogenase) assays assessing the cytotoxicity of temporin-1CEa nanofibers against the human melanoma cell line A-375. Results indicate that the peptide-nanofiber complex maintains anticancer activity while allowing for localized treatment. Statistical analyses, including ANOVA, or Analysis of Variance, ($F(3,8) = 8.87$, $p = 0.0063$), revealed that the peptide-nanofiber complex was significantly more cytotoxic than 5-FU ($p < 0.05$). These findings suggest that nanofiber-based ACP delivery could serve as an effective, targeted treatment for melanoma. This project is the first to develop and test a non-synthetic nanofiber-anticancer peptide platform, reducing ACP off-target effects significantly. Given temporin-1CEa's broad spectrum activity, the biomaterial could be adapted globally to treat other cancers topically.

Mentor(s): Katherine Davis, Blacksburg High School
Nic Burns, Biological Systems Engineering, Virginia Tech

Audrey Prendergast
Virginia Tech/Biochemistry

Structure-Guided Ensemble Docking and Screening for Broad-Spectrum Small-Molecule Inhibitors of RNA Viruses

Limited treatment and vaccine options for the RNA viruses Chikungunya (CHIKV), Dengue (DENV), and Zika (ZIKV) underscore the need for novel antiviral strategies. This study addresses the lack of targeted and broad-spectrum therapeutics for CHIKV, DENV, and ZIKV by investigating small-molecule inhibitors capable of both site-specific and dual-warhead inhibition. Here, we have generated a diverse set of binding pocket conformations from apo molecular dynamics (MD) simulations of proteases, methyltransferases, and RNA-dependent RNA polymerases from CHIKV, DENV, and ZIKV, providing multiple conformational states for ensemble docking. Sampling across these distinct structural conformations enhances the ability to capture relevant ligand interactions and supports consensus scoring across structural variability. Preliminary docking analysis has identified key exploitable features within the polymerase binding pockets of apo-derived structural clusters, including conserved interaction hotspots and pharmacophoric constraints that differentiate between binding modes. These findings enable more informed ranking and prioritization of candidate inhibitors and will guide ongoing screening of the ZINC database, as well as rational derivatization of lead compounds to enhance selectivity and antiviral activity. Successful development of small-molecule inhibitors for these RNA viruses poses the implication of greatly improved medical care in regions highly affected by these diseases and opens a door to further drug discovery for other RNA viruses.

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

Alex Probst
Virginia Tech/Psychology

The Role of Headphones in Expressing Interpersonal Gratitude: An analysis from naturalistic behavioral observations

Interpersonal gratitude—the expression of thankfulness toward another person—increases overall wellbeing for those who express and receive gratitude. Technology advancements have led to an increase in headphone use in public spaces, resulting in a decrease in interpersonal conversations. Such decreases may lead to a decline in sociability and instances in which interpersonal gratitude is expressed, leading to a reduction in individual wellbeing and life satisfaction. This naturalistic behavioral study observed and analyzed the effect of headphone use on expressions of interpersonal gratitude (EOG). At two university dining facilities, trained observers recorded whether customers expressed gratitude to their cashier, and how many headphones they were wearing (none, one, or two headphones). The two campus locations were chosen because they provided a systematic opportunity for EOG between two people. A total of 6,123 customer-cashier interactions were observed, recorded, and analyzed. The percentages of customers who expressed gratitude while wearing no headphones (55%) were substantially larger than the gratitude-expression percentages among customers wearing one headphone (8%) and two headphones (12%). There were substantial differences in EOG across the two locations, suggesting the impact of environmental factors. At the “Student Center”, 50% of customers expressed gratitude, while at the “Academic” location, only 26% expressed gratitude to their cashier when checking out.

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

Shahnoor Qazi
Virginia Tech/Biological Sciences
Rubisha Dhungel
Virginia Tech/Biochemistry
Bobby Cheng
Virginia Tech/General Engineering

Light Pollution's Effects on the Circadian Rhythm of a Night-Blooming Plant Species

As the world faces increasing levels of light pollution, it is important to understand how wildlife may or may not be impacted by manmade artificial lighting. Our project focused on the impact of light pollution on the circadian rhythm of the Night Blooming Cereus (plant). We chose to focus on the Night Blooming Cereus because they are light sensitive and only bloom under dark conditions. This led us to our research question, how is the circadian rhythm of the night blooming cereus affected when placed in a low light pollution city (e.g., Honolulu, Hawaii) versus a high light pollution city (e.g., Washington, D.C.)? Our analyses were based off finding overlaps between night pollution levels around the world where these flowers bloom to illustrate whether night pollution influenced the number of flowers bloomed in the region. We did this by finding and comparing publicly available data on light pollution and Cereus populations. We predict that the number of flowers blooming within regions of higher light pollution levels will be reduced compared to regions with lower light pollution levels. This is due to the fact that the Night Blooming Cereus needs a very dark environment to bloom.

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

Eliza Quesenberry
Virginia Tech/Professional and Technical Writing
Katelyn Morris
Virginia Tech/Cognitive and Behavioral Neuroscience

Voices of Voice Assistants

We examine the impact of Voice Assistant (VA) accent on user experience and recall, comparing Southern (SUSE) and Mainstream US English (MUSE) accents. 24 native speakers of US English, either from Northern Virginia or the South, believed they were user-testing new VA systems. In regards to participants' subjective feelings, participants rated the MUSE VA as more friendly, understandable, intelligent, and faster than the SUSE VA. When explicitly asked to state a preference, the MUSE VA was chosen 62% of the time, with some participants citing intelligibility as a reason. However, we also assess memory recall of the VA's content, using the False Memory Paradigm (Roediger et al. 1995), and Northern participants falsely recalled the lure to similar degrees for both MUSE VA and SUSE VA, while Southern participants recalled fewer lures with the SUSE VA. This suggests that Southern participants may be encoding SUSE speech better than MUSE speech. We are in the process of collecting more data.

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

Daniel Ra
Virginia Tech/Computer Engineering
Drew Burcher
Virginia Tech/Mechanical Engineering
Aidan Milloy
Virginia Tech/Electrical Engineering
Peter Mangan
Virginia Tech/Electrical Engineering

Exploring Gradiometric Measuring Capabilities Using a Helmholtz Coil

Accurate measurement of variations in a given magnetic field is essential in object detection and geophysical surveying, commonly requiring the use of two or more magnetic sensors for differential measurement and calculation. Specifically, measuring the change in a magnetic field rather than the total magnetic field strength at a particular point becomes especially useful when the magnetic signature is miniscule or far away. To assess the advantages and drawbacks of pre-existing gradiometry strategies, this research effort will primarily focus on magnetic field generation via a Helmholtz coil and the measurements of this generated field using fluxgate and MEMS (microelectromechanical systems) magnetometers. A Helmholtz coil serves as a controllable test bench capable of simulating different objects and geophysical attributes by varying the current flowing through its coils. By horizontally “sliding” two magnetometers at a fixed distance through the coil, we expect to see a non-zero rate of change reading as one of the magnetometers surpasses one of the coil’s bounds. Additionally, by analyzing differences in measurement accuracy and stability, we seek to identify the strengths and limitations of different sensor types for gradiometry application. The insights gained from this research will not only provide the New Sensors team with valuable experience but also better position us to aid the United States Army in their object detection efforts alongside the Optical Standoff team under GrayUR.

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

Annabella Racioppi
Virginia Tech/Biochemistry
Grant Palmere
Virginia Tech/Biochemistry
Emily Moreau
Virginia Tech/Biochemistry
Ava Hamilton
Virginia Tech/Biochemistry
Ola Khashan
Virginia Tech/Biochemistry

Investigating a Point Mutation at the 216 Residue in Adenosine Deaminase to Determine the Binding Affinity to 9-Deazainosine

Adenosine deaminase (ADA) is an enzyme that converts adenosine into inosine. Adenosine, a byproduct of DNA synthesis and purine metabolism, is toxic to lymphocytes, and its accumulation can lead to immune system deficiency. The objective of this experiment was to determine whether a point mutation at residue Q216 in ADA affects the binding affinity of the ligand to the protein. To test this, molecular visualization was used to introduce a mutation at glutamine-216, replacing it with various amino acids, including glutamic acid (Q216E). The modified protein-ligand complexes were then analyzed using molecular docking software to assess binding positions and predicted binding affinities. Several point mutations—Q216E, Q216A, Q216S, and Q216N—were simulated. Results showed that all mutations at this position significantly reduced predicted binding affinity, with values ranging from approximately +9.0 to +20.0 kcal/mol, indicating less favorable interactions. These findings suggest that residue Q216 plays a key role in stabilizing ligand binding within ADA's active site. In conclusion, mutations at Q216 negatively affect ligand binding and may impair the enzyme's ability to process adenosine into inosine. This loss of function could contribute to immune deficiency in individuals carrying such mutations.

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

Ahtumn Rains
Virginia Tech/Chemistry
Alexandra Mkrtchyan
Virginia Tech/Philosophy, Politics and Economics
Christian Truong
Virginia Tech/Mechanical Engineering

Beyond the hide: A mycelium leather exploration

Animal-based leather production raises significant environmental and ethical concerns due to its reliance on livestock, water-intensive processes, and the use toxic chemicals during tanning. Mycelium-based leather, made from the root-like structures of fungi, presents a promising sustainable alternative. This project aims to identify key barriers to implementing mycelium leather, with a particular focus on tanning processes. We conducted a deep literature review on conventional tanning methods used in animal leathers to understand how these processes influence physical properties like flexibility and durability. This research highlighted a lack of sustainable, effective tanning processes specifically designed for mycelium.

To complement this work, we collaborated with a graduate student researcher to observe how mycelium sheets are cultivated. We qualitatively assessed plasticized mycelium samples and found they mimicked some textural features of leather but lacked the same toughness and resilience. These insights confirmed the importance of developing MBL-specific tanning strategies.

Looking ahead, we recommend future teams expand the literature review to explore eco-friendly tanning alternatives and begin systematic quantitative characterization—including tensile strength testing—of both commercial animal leathers and mycelium-based leathers. Establishing performance baselines will be critical for evaluating and optimizing new treatments.

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

Nethra Rajeshkumar
Virginia Tech/Computational and Systems Neuroscience
Seneca McCaw
Virginia Tech/Cognitive and Behavioral Neuroscience
Ariana Hill
Virginia Tech/Cognitive and Behavioral Neuroscience
Megan Mansfield
Virginia Tech/Biochemistry

Empowering Minds: Unraveling the Neuroscience of Drug Addiction for Informed Choices

The Neuroscience of Drug Addiction course we're currently enrolled in integrates service learning into its curriculum. Our project aims to facilitate a field trip called Brain Day for high school students from E C Glass High School in Lynchburg, VA. This day-long program will help high school students understand the science behind drug addiction so they can make informed decisions rather than being told not to do drugs. Further, we hope to empower the students to share this knowledge with their community members beyond the participants of the program. This program includes three different components: the Just Say KNOW presentation, which informs students about responsible decision-making regarding substance use; an MRI/fMRI demonstration, which gives students a glimpse of the effects of substance use on the brain; and a hands-on neuroscience activity related to substance use research. We will also host a career panel aiming to expose students to career prospects with a neuroscience education. Throughout this experience, we anticipate gaining more knowledge on how we can use our course materials to make an impact within our community and take what we learned and apply it firsthand in the field. We hope to gain an insight into making a valuable contribution for the students, and in turn, we hope that the students take away our message on making informed decisions regarding substance use.

Mentor(s): Aparna Shah, College of Neuroscience, Virginia Tech
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Rahul Rengan Ramakrishnan
Virginia Tech/CMDA

Understanding Dengue in the Dominican Republic: Epidemiological Trends and a Path Toward Machine Learning–Based Outbreak Prediction

Dengue is a mosquito-borne disease endemic to many tropical regions of the world. In recent years, dengue incidence has increased significantly, and in 2024, over 13 million cases were reported across the Americas in the largest global dengue outbreak to date. This project explores the demographic, geographic, and temporal dynamics of dengue fever in the Dominican Republic between 2015 and 2023, with a long-term goal of building a predictive machine learning model for outbreak detection and the classification of outbreak severity. The central research questions of this project include: which demographic groups are most affected by dengue, which provinces carry the highest disease burden, and how delays in case reporting and outbreak timing vary across regions.

Through answering these questions, this work will contribute to the development of data-driven tools for improving public health surveillance and dengue intervention planning. In this project, we utilize national dengue surveillance data that includes information on patient demographics, symptoms, geographic locations, and key clinical timestamps such as the timing of symptom onset and case notification. We combine this data with national census and survey datasets to conduct an exploratory statistical analysis aimed at understanding the drivers of spatial heterogeneity in dengue cases across the country.

This work serves as a foundation for training and evaluating machine learning models capable of predicting severe dengue cases and forecasting outbreak progression using regional and patient-level features. With these models, we hope to identify critical factors associated with severe cases and delayed reporting, and to develop a machine learning framework for predicting high-risk outbreaks. These tools will support public health officials in allocating resources more effectively and improving response efforts during future dengue epidemics.

Mentor(s): Michael Robert, Department of Mathematics, Virginia Tech

James Rashkovsky
Virginia Tech/Microbiology

Auxin Uncoded: A Comparative Analysis of Auxin Response Factors via RNA-Sequencing

A major player within the auxin signaling pathway in plants is the Auxin Response Factor (ARF), which can drive or repress gene expression in response to the presence of auxin. One issue in our understanding of this pathway is that it is difficult to see the differences between the different ARFs within the plant, both conformationally and physiologically. In our study, we overly expressed truncated versions of different ARFs and extracted the RNA for RNA-sequencing. With the RNA-Seq data we used R studio to visualize the data and perform a comparative analysis of each of the ARFs. By using R to perform a GO analysis, we were able to derive some difference in gene expression. Our next steps would include comparing common motifs within the DNA binding regions for each ARF and seeing if there is any difference.

Mentor(s): Bastiaan Bargmann, School of Plant and Environmental Sciences, Virginia Tech
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My TaleMate: The Impact of Parent-Child Joint Reading with AI Voice Agents on Young Children's Pattern Recognition Learning

Reading with parents supports children's language and cognitive skills. However, storytelling may be challenging for parents to engage their children. Although interactive e-books support learning, their design often limits parent involvement. Voice agents (VAs) offer interactivity, but their role in supporting parent-child reading remains underexplored. This study examined the impact of parent-VA role-playing on children's patterning skills and reading experiences. Data were collected from 23 dyads of parents (Mage = 36.65 years, SD = 3.93, 22 mothers) and children (Mage = 66.61 months, SD = 8.78, 11 girls) across two within-subject conditions: VA and Non-VA. We assessed children's learning (Pattern Knowledge Task) as well as both parents' and children's story comprehension and perceptions of TaleMate (User Experience Questionnaire). We conducted separate repeated-measures ANOVAs for each outcome, controlling for child age, sex, and pre-test pattern, and number recognition knowledge. Children's pattern recognition scores were slightly higher in the VA condition (M = 4.17, SD = 1.19) compared to the non-VA condition (M = 4.00, SD = 1.51). Children's and parents' comprehension and UX scores were similar between the conditions. Preliminary data suggests parent-child joint reading with AI voice agents has the educational potential to teach young children patterning skills.

Mentor(s): Koeun Choi, Human Development and Family Science, Virginia Tech
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Kinematic Insights into Older Adult Fall-Related Head Impacts: Boundary Conditions and Injury Risk

The majority of traumatic brain injuries (TBIs) in older adults are caused by falls. This study aims to quantify real-world head impact conditions and kinematics in older adult falls. An open-source dataset of 300 fall videos from long-term care facilities (82.8 ± 7.6 years old) were evaluated for head impacts. Model-based image matching was used to track head impact velocities. Impacts were reconstructed using an inverted pendulum with a Hybrid III headform. A linear model examined the effect of fall characteristics on peak linear acceleration (PLA) and peak rotational acceleration (PRA). Of the falls, 118 had a head impact. Twenty nine videos captured falls in a perpendicular view and were tracked, finding 1.76±1.02 m/s normal velocity and 1.27±0.95 m/s tangential velocity. Twenty three impacts were reconstructed, producing PLA 50.2±36.4 g and PRA 2.91±2.16 krad/s2. The falls analyzed in this dataset did not have any resulting catastrophic injuries, aligning with our findings. Impacts that occurred against the floor had a 38% higher PLA and a 25% higher PRA compared to wall impacts. Compared to backward and forward falls, lateral falls resulted in 46-52 g higher PLA and 3.12-4.66 krad/s2 higher PRA. Fall direction and impact surface influenced head impact accelerations, with certain fall configurations posing a greater risk for TBIs. These findings provide insights into the biomechanics of older adult head impact falls highlighting the need for targeted fall prevention strategies and protective measures.

Mentor(s): Nicole Stark, Biomedical Engineering and Mechanics, Virginia Tech

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Virginia Tech/Biochemistry
Sydney Nash
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Hannah Ayele
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Evaluating Alvimopan as an Alternative to Naloxone for Mu-Opioid Receptor Antagonism

The mu-opioid receptor (MOR) plays a significant role in pain modulation and opioid pharmacology. Naloxone, a widely used opioid antagonist, reverses opioid overdoses by binding to MOR and preventing its activation. However, Naloxone has drawbacks, including a short half-life and the induction of withdrawal symptoms in opioid-dependent individuals. Alternative opioid antagonists such as Alvimopan, primarily used to treat postoperative bowel dysfunction, may have fewer disadvantages. This study examines the effect of substituting Naloxone with Alvimopan in the MOR binding pocket using molecular docking and three-dimensional structural visualization. Naloxone and Alvimopan were docked into MOR, and predicted binding free energy and root-mean-square deviation (RMSD) values were recorded for nine generated ligand conformations. Naloxone exhibited more favorable binding, with predicted free energy values ranging from −7.8 to −9.1 kcal/mol, whereas Alvimopan showed slightly weaker binding, with values ranging from −7.8 to −8.6 kcal/mol. Additionally, for the best-scoring conformation, Alvimopan displayed higher RMSD values (2.6–4.2 Å) than Naloxone (1.6–2.0 Å), suggesting that Alvimopan adopts a less consistent or optimal orientation within the MOR binding site compared to Naloxone. These data highlight how structural differences between opioid antagonists influence receptor binding interactions. Future studies could explore additional ligand substitutions or investigate how mutations in MOR affect ligand binding, which may inform the design of more effective treatments for opioid addiction and overdose.

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

Kailynn Roberts

Virginia Tech/Biochemistry

Methodology to Assess Immune Cell Control of Endothelial Cell Fate Following Vascular Injury

Endothelial cells (EC) are the first layer of cells present in blood vessels and are vital for maintaining the overall health of a blood vessel. EC are often damaged by surgery, and this damage is a primary contributor to vascular surgery failure and patient mortality. Therefore, it is necessary to study the processes that regulate EC wound healing. Damage to EC can lead to their proinflammatory signaling, which recruits immune cell types such as macrophages (Φ) to the site of injury. In serial block face SEM (SBFSEM) data of injured blood vessels, Φ have been shown to make close contacts with EC. In these areas of close contact, electron dense regions between Φ and EC have been shown, which is an indication of gap junction formation. Gap junctions are protein channels composed of connexins (Cx) that allow direct cell-to-cell communication; Φ and EC express similar connexins. RNAseq data (accession number GSE115618) of injured aorta lumen cells, EC and recruited Φ, shows injury-induced increases in the expression of Cx43. It is unknown if Φ and EC make direct gap junction communication and if Φ signals passed to EC control their behavior or phenotype. My research aims to understand Φ-EC gap junction communication and its role in changes of EC phenotype and function that may be important for damage repair. To begin studying this, I have developed cell culture models to assess injury induced Φ-EC communication. Initial cell culture models with human umbilical vein EC (HUVEC) and THP1 monocytes, have shown that scratch injuries to EC promotes migration of monocytes to site of injury. At the site of injury, monocytes become more Φ like in phenotype and EC in close contact with monocytes appear phenotypically different. This project on immune cell interactions with EC will allow us to have a greater understanding on how to improve vascular healing.

Mentor(s): Scott Johnstone, Biological Sciences, Virginia Tech

Abigail Robertson
Virginia Tech/Mathematics

Exploring Comorbidities of Chronic Pain and Connective Tissue Disorders

With more symptoms than I can remember, my disability has left both myself and medical professionals at a loss. Diagnosed with joint hyperlaxity, among other conditions, I endure chronic, widespread pain that, for now, is incurable. Curious to learn more about treatments, comorbidities, and struggles I would encounter, I began my research. Over the course of almost a decade, I have compiled stories about being mistreated, dismissed, and outright disrespected by medical professionals, but I have also gained knowledge of the human body, the mind, the importance of mental health, and socioenvironmental factors that affect health. In an attempt to (1) provide an in-depth, comprehensive analysis of my experience, and in doing so (2) bring awareness to a population that has been historically misrepresented in the medical community, this analysis of literature provides evidence for various multi-directional comorbidities of hypermobile syndromes and articulates unique challenges I endured as a result of my condition. Case studies, while not entirely generalizable, are an integral mechanism in categorizing, researching, and curing ailments that affect a certain population. I have spoken to many people suffering from conditions similar to mine, and in turn, I noticed that this population wasn't diverse, they were mostly young women. Further, I investigated the links between emotion regulation and pain, as well as pain and cognitive dysfunction. I plan to continue research in this area to benefit underrepresented populations.

Mentor(s): Heath Hart, Mathematics, Virginia Tech
Dr. Rachel Arnold, Mathematics, Virginia Tech

Julia Rocha
Virginia Tech/Architecture

Kinetic Facade Design Utilizing Polarization Technology for Indoor Light Control

This project investigates how polarizing filters can be used in a kinetic facade system to dynamically manage natural light in architectural spaces. The central question asks: Can an adaptive, low-cost facade using overlapping polarizing filters provide effective control over daylight and glare in real time?

As buildings increasingly rely on daylight for energy savings and occupant well-being, conventional shading systems—like blinds or fixed louvers—often fall short. They are typically static, visually intrusive, or require costly electronic components. This project proposes a new solution that is simple, responsive, and affordable, using the physical principle of polarization to adjust how much light enters a space.

The system works by rotating one polarizing filter in front of another. As the angle between them changes, so does the amount of light that passes through. A working prototype was developed using 3D-printed gears and an Arduino-controlled motor, allowing the filters to rotate automatically in response to light levels or user input.

The anticipated result is a functional, adaptable facade unit that can demonstrate how this approach could be applied in future building designs. By combining physical principles with mechanical design and automation, this project offers a new way to think about light control in architecture—one that is sustainable, elegant, and grounded in real-world performance.

Mentor(s): Sida Dai, Architecture, Virginia Tech

Hyun Roh

Virginia Tech/Computational Modeling and Data Analytics

Efficient Large Language Models for Modernizing Early Modern English Texts

This study explores how pre-trained large language models (LLMs) can be efficiently trained to modernize Early Modern English texts, addressing the challenge of bridging historical linguistic forms with modern language. The project aims to enhance the accessibility and scholarly usability of historical documents by reducing the complexity of outdated language while preserving the original content's nuances. To do this, we used both full fine-tuning of LLMs and LoRA, a parameter-efficient fine-tuning method for LLMs, on a parallel corpus of historical texts and their modernized translations. Our methodological framework involves comparative experiments that evaluate various configurations of fine-tuning techniques across multiple open-source LLMs (such as Gemma, Llama, Phi, and Qwen) with different parameters, and further compare the performance of these fine-tuned models to their original versions as well as to proprietary LLMs (such as GPT, Gemini, and Claude). Performance is evaluated using the Crosslingual Optimized Metric for Evaluation of Translation (COMET) metric, a LLM-based evaluation measure that correlates closely with human translation quality. Anticipated results should show that our fine-tuned LLMs achieve higher COMET scores than proprietary LLMs, indicating not only better translation quality but also a reduction in computational resources relative to the expensive and less time efficient proprietary LLMs. By providing a way to produce high-quality modernized versions of historical texts, this can enhance a historian's ability to perform large-scale linguistic analysis, comparative historical research, and the bridging the gap between historical texts to the general public.

Mentor(s): Chreston Miller, University Libraries, Virginia Tech

Melanie Rosenblatt
Virginia Tech/Biological Sciences

The Impact of Culture Medium on CT1 Trophectoderm Cell Viability: A Comparative Study

CT1 trophectoderm cells, derived from bovine blastocysts, play a crucial role in early embryonic development and implantation. Optimizing culture conditions is essential for maintaining cell viability and function in vitro. This study investigates the effects of three different culture mediums: DMEM with FBS, DMEM alone, and DMEM with B27 on CT1 trophectoderm cell viability. Cells were cultured under controlled conditions, and viability was assessed using the XTT assay, which measures metabolic activity as an indicator of cell survival. Data analysis compares the effectiveness of each medium in supporting CT1 cell growth and maintenance. These findings contribute to improving in vitro culture systems for bovine trophectoderm cells, with potential applications in reproductive biology and assisted reproductive technologies. It is predicted that DMEM with FBS will have the highest cell viability, and DMEM will have the lowest cell viability.

Mentor(s): Alan Ealy, School of Animal Sciences (Reproductive Physiology), Virginia Tech
Amber Thornton, School of Animal Sciences (Reproductive Physiology), Virginia Tech

Grayson Ryan
Virginia Tech/Architecture

Architecture and Neuroscience: Neural Entrainment within Architectural Rhythm

Architecture and the built environment shape nearly every aspect of daily human experience; However, the impact of architectural design on human experience remains largely underexplored. This research draws from architecture, phenomenology, and cognitive neuroscience to examine the role of architectural rhythms, understood as visually repetitive elements in the built environment, and their role in affecting our everyday experience, notably through neural entrainment—the synchronization of neural activity with external rhythmic stimuli. While previous studies have demonstrated neural entrainment in response to sound, flashing lights, and moving patterns, participants in these studies remained stationary. This pilot study introduces movement as a fundamental component of spatial experience, hypothesizing that movement-induced rhythmic flickering can evoke neural entrainment. Using Virtual Reality, participants walked back and forth in two corridors featuring rhythmic and arrhythmic conditions, both with and without vertical light strips, while completing a selective attention task. Their neural responses were recorded via a 64-channel mobile electroencephalograph (EEG). Preliminary data (N=4) suggest that movement-induced rhythmic flickering in the visual periphery can induce neural entrainment, as evidenced by a power spectral density analysis over the occipital cortex. These findings highlight the potential for architects to leverage rhythmic design elements to shape sensory experiences, potentially enhancing attention or modulating sensory processing. This research also advances neuroscience by exploring new conditions for neural entrainment and related phenomena while offering further insights into brain responses to architectural stimuli. By contributing toward bridging architecture and neuroscience, the research helps provide a new perspective on how design elements can shape and optimize human interaction with the built environment.

Mentor(s): Zakaria Djebbara, Department of Architecture, Design, and Media Technology, Virginia Tech

Tahoura Safari Tooj
Virginia Tech/Electrical Engineering

Automated Analysis of Cancer Cell Images acquired using phase-based microscopes

Early detection and accurate diagnosis of cancer are essential for improving patient outcomes. However, traditional microscopy methods are often prohibitively expensive and inaccessible in resource-limited settings. This study explores the use of phase-based microscopes as a cost-effective and accessible tool for cancer diagnostics. By automating the analysis of cancer cell images, these devices enable precise evaluation of cellular morphology and treatment responses, distinguishing between apoptosis and necrosis.
Our research examines the effects of the chemotherapy drug DOX (Doxorubicin) and hydrogen peroxide (H2O2) on cancer cells, revealing significant morphological changes in cell area, diameter, intensity, entropy, and roundness over time. Through advanced imaging techniques and machine learning algorithms, phase-based microscopes enhance diagnostic accuracy and facilitate personalized treatment strategies. The integration of decrowding expansion pathology (dExPath) technology allows for detailed nanoscale analysis, providing insights into the cellular dynamics of cancer progression.
Beyond cancer research, phase-based microscopes have the potential to empower healthcare providers by enabling rapid, on-the-spot screenings and informed decision-making. This study highlights the transformative impact of phase-based microscopy in democratizing healthcare access, advocating for the integration of innovative technologies to advance personalized medicine and improve global health equity.

Mentor(s): Aniruddha Ray, Physics, Virginia Tech

Nathaniel Salzberg
Virginia Tech/Wildlife Conservation

Identifying Fig - Fig Wasp Interactions in the Mariana Islands

Figs and fig wasps share an ancient obligate pollination mutualism, yet the identities of wasp pollinators for many fig species—especially in understudied island ecosystems like the Mariana Islands—remain undocumented. This study addresses two questions: (i) Which fig wasp species are associated with Ficus prolixa and Ficus tinctoria, the most common fig trees in Guam and Saipan? (ii) Do pollinator species differ between Guam, Saipan, and other regions within their range?

Figs were collected in limestone forest in Guam and Saipan in July 2024 and placed in individual vials for wasp emergence. Once emerged (typically >30 individuals per fig), 75% isopropyl alcohol was added for preservation. Specimens were shipped to Virginia Tech and stored at -80°C. I captured high-resolution images of each wasp for morphological identification. Wasps from each fig were sorted by morphology, with one representative per morphotype selected for DNA extraction. Both destructive and non-destructive extractions were attempted using an E.Z.N.A.® Mollusc & Insect DNA Kit and a Qiagen DNeasy Blood & Tissue Kit, respectively. The mitochondrial COI Folmer region will be amplified using primers UEA3 and HCO2198, followed by Sanger sequencing.

Fig wasps, and Hymenoptera more broadly, are difficult to sequence, and DNA extraction and amplification have so far been unsuccessful. Nonetheless, we expect to find novel pollinator species and distinct lineages for each fig species, though likely the same wasps across islands. This work provides the first genetic barcodes for Mariana fig wasps, fills a key biogeographic gap, and supports future evolutionary and conservation research.

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

Gavyn Sanford
Virginia Tech/Biological Sciences

Mosquito Diversity, Arbovirus Surveillance, and Host-Feeding Patterns in Western Virginia

Mosquito-borne arboviruses are a growing concern in the United States, yet surveillance in rural regions often remains sparse. In Virginia, state surveillance is limited to urban centers, leaving inland counties in the Appalachia underserved in vector monitoring, with poor understanding of arboviral threats and transmission cycles. This study aims to fill critical gaps in mosquito species diversity, host-feeding behavior, and arbovirus prevalence across western Virginia. Weekly mosquito collections were conducted in summer 2023, 2024, and ongoing in 2025 across up to five counties using BG-Pro, CDC light, and GAT traps, deployed in both urban and sylvatic habitats. Specimens were identified to species level, pooled by trap-type, site, and week, and then screened for arboviruses using cell culture and PCR-based diagnostics. Engorged females were subjected to blood meal analysis via DNA extraction and amplification of the 16s rRNA gene and sequencing. Preliminary results from 2023 yielded 997 mosquitoes from 18 species across 7 genera, including Aedes albopictus, Aedes japonicus, Culex pipiens, and Anopheles punctipennis which are known vectors of various arboviral pathogens. Screened as 424 pools, samples from 2023 revealed West Nile virus in Rockingham and Rockbridge counties. Blood meal analysis indicates feeding on a broad range of hosts, including humans and wildlife. These findings provide the first regional catalog of mosquito diversity and arboviral activity in this underserved region. Continued sampling will enhance understanding of vector-host-pathogen dynamics and inform local public health and vector control strategies.

Mentor(s): Gillian Eastwood, Department of Entomology, Virginia Tech
Dr. Chloe Lahondere, Department of Biochemistry, Virginia Tech

Sneha Sapkota
Virginia Tech/Exercise and Health
Logan Torio
Virginia Tech/Human Nutrition, Foods, and Exercise

Use of an Acute Vigorous Exercise Intervention to Improve Academic Success – Effect of Genetics

TITLE: Use of an Acute Vigorous Exercise Intervention to Improve Academic Success – Effect of Genetics

AUTHORS: Sneha Sapkota 1, Logan Torio 1, Angela Anderson 1, Grace Boyer 2, Simon Leonessa 3, and Deborah J. Good 1
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Previous work from our group and others have shown a correlative link between body mass index (BMI), exercise frequency, and grade point average. In a repeated-measures cross-over design, we sought to understand these findings by exposing college-aged students to either a short bout of intense exercise or a similar length of sedentary time, followed by cognitive testing. Moreover, during this study, participants provided a DNA sample for genotype analysis. The study consisted of 32 participants who each took CANTAB cognitive assessments following a sedentary or acute aerobic exercise condition. The difference in cognitive testing scores between the groups was calculated. Results showed memory was improved following an acute bout of exercise as compared to the sedentary condition, and was correlated with significant differences between genotype allele variant groups and several of the exercise testing cognitive results. Our findings suggest that genetics play a role in allowing some individuals to respond better to an exercise intervention with improvement of memory and cognition. Further research is being conducted to analyze the impact of various single nucleotide polymorphisms (SNP) of select genes, on the genetic interaction between cognitive ability and exercise.

Mentor(s): Deborah Good, Human Nutrition, Foods, and Exercise, Virginia Tech
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Maanya Sappa
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Investigating the role of FMRP in localized RNA regulation in hippocampal CA1 dendrites

Dysregulated local translation at synapses is a common cause of neurodevelopmental disorders, such as Fragile X Syndrome (FXS). FXS results from the silencing of FMRP (Fragile X Messenger Ribonucleoprotein), an RNA-binding protein that binds to target RNAs and represses translation—a process critical for fine-tuning synaptic function and plasticity. FMRP associates with approximately 300 mRNAs in the mouse hippocampal synaptic neuropil. However, it remains unknown how the vast majority of these neuropil-localized RNAs are spatially organized near synapses and whether they are impacted by FMRP loss. We visualized three putative FMRP target RNAs (Adcy1, Psd, and Dlg4) in P17 mouse hippocampus to compare RNA spatial distributions in wild-type (WT) and FMRP knockout (KO) mice (N = 4 per genotype). We measured RNA abundance, fluorescent puncta area, and pairwise colocalization patterns within the hippocampal CA1 neuropil. Based on existing literature, we hypothesized that Dlg4 would display higher colocalization with Adcy1 and Psd due to its greater abundance and typically larger puncta size, whereas Adcy1 and Psd would show lower colocalization frequencies, variable puncta sizes, and reduced abundance relative to Dlg4.

Our preliminary data revealed no significant differences in the abundance of these RNAs between genotypes. The RNAs exist as variably sized fluorescent puncta, and the average puncta area and distributions were unchanged by FMRP loss. Dlg4 puncta are uniformly larger in area compared to Adcy1 and Psd puncta, which have a broader area distribution consisting of both small and large puncta. Interestingly, the area distribution of Psd puncta are noticeably different between genotypes whereas Adcy1 and Dlg4 area distributions did not vary due to the absence of FMRP. This data suggests that FMRP loss does not impact the abundance of these RNAs in the CA1 neuropil but may influence the copy number states of specific RNAs. To assess whether these RNAs are potentially co-regulated within the same puncta, we measured pairwise colocalization patterns using properly registered images and a control condition in which one channel was rotated 180 degrees (random overlap). This analysis is ongoing, but we predict, based on our previous work, that (1) colocalization will correlate with the abundance of the RNAs in both genotypes, and (2) specific RNAs might demonstrate genotype-dependent changes in their shared colocalization patterns in FMRP KO mice, reflecting FMRP's role in RNA packaging into RNPs, which in turn influences how its target RNAs are spatially organized and localized within the synaptic neuropil.

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Renee Sarmiento
Virginia Tech/Biochemistry

Direct macrophage-smooth muscle cell interactions in the injured arterial wall

Cardiovascular disease, driven primarily by atherosclerosis, remains the leading cause of death worldwide. Atherosclerosis, a chronic inflammatory disease, results from the accumulation of fats, cholesterol, and other substances in artery walls. Arterial blockages are typically treated by stent placement to restore blood flow. However, this often triggers local inflammation and vascular smooth muscle cell (VSMC) proliferation, leading to re-occlusion and neointima formation. Based on RNA sequencing data (GSE115618) showing rapid macrophage (Φ) accumulation at injury sites, we hypothesized that Φ initiate VSMC proliferation and neointima formation through Connexin 43 (Cx43) gap junctions following vascular injury. To test the hypothesis, we induced carotid artery injury in C57BL/6 mice through permanent (1-14 day) carotid ligations. Carotids were assessed to visualize cell-cell interactions in the vessel wall via histology, immunofluorescence, and electron microscopy. Results in vivo showed that Φ accumulated within the carotid ligation 3 days post-injury, coinciding with areas of highest neointima burden observed 14 days post-injury. Confocal microscopy revealed Cx43 gap junctions at breaks in the internal elastic laminar between Φ and VSMC 3 days post-injury, which were confirmed by electron microscopy. These findings suggest that Φ rapidly localize to injury sites and establish direct Cx43-mediated contact with VSMCs; however, Φ-specific Cx43 knockout did not prevent neointima formation, indicating that this interaction alone may not drive the inflammatory cascade. Ongoing studies using inducible, VSMC-specific Cx43 knockout mice will evaluate the contribution of VSMC Cx43 signaling to neointima development. Overall, understanding the pathways of neointima formation is crucial for developing targeted therapeutics.

Mentor(s): Scott Johnstone, Biological Sciences, Virginia Tech
Dr. Mark Renton, The Fralin Biomedical Research Institute at Virginia Tech Carilion, Center for Vascular and Heart Research

Ivan Savelyev
Virginia Tech/Psychology

Behavioral and Environmental Determinants of Gratitude Expressions: Naturalistic Observations

Expressions of gratitude have been shown to boost subjective wellbeing for both the benefactor and the beneficiary of a gratitude expression (GE). Previous CABS research has shown only 14.8% of over 21,000 students express gratitude in Virginia Tech crosswalks. This study aimed to identify which human dynamics and environmental variables are associated with gratitude expression to drivers of stopped vehicles. Trained students observed and recorded certain human dynamics occurring after a vehicle stopped for 677 pedestrians in downtown Blacksburg and for 908 pedestrians on the Virginia Tech campus, including the pedestrian's facial expression, social interactions, phone use, age category, and GE. Independent samples t-tests showed a significant difference in frequency of GE between the downtown (49%) and the campus locations (19%), p=<.001), as well as between people smiling (59%) and those not smiling (27%), (p=<.001). Also, substantial differences in frequency of GE were observed as a function of the pedestrian's age. Those aged 30-50 and 50+ showed gratitude 47% and 54% of the time respectively, while pedestrians in the 18-30 age-category showed gratitude on 28% of occasions. A linear probability model was used to find the effect of each predictor on gratitude controlling for all other variables. Pedestrians aged 30-50 were 9.2 percentage points more likely to express gratitude than the reference group (ages 18-30) (p= 0.012), and pedestrians aged 50+ were 11.6 percentage points more likely to express gratitude (p= 0.038). These findings suggest major generational differences in GE and inspire the design of community-based interventions to increase GE.

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

Katy Schurtz

Virginia Tech/Environmental Conservation & Society

Resilience at the Local Level: Mapping Spatial Disparities in Food System Planning in Central Appalachia

Food system functionality is threatened by the increasing intensity of climate change, which exacerbates natural disasters like flooding and hinders the provision of food security. Consequently, embedding resilience in these systems is essential and will require sustainability, equity, and planning on both local and regional levels. However, food system planning in rural areas is systematically neglected and under-resourced. This project focuses on Central Appalachia, where 10% of the population is defined as rural and food insecurity rates are higher than the national average. It is crucial to recognize the importance of local action and that government capacities vary in food system resilience planning. As such, we aim to produce a visual representation of the spatial disparities among local governments across the region. The principal research question investigates how municipality and county government leaders in Central Appalachia are addressing food systems resilience. I will collect secondary data from municipal and county websites, looking for the presence of food system plans and the employees which support their realization. Subsequently, we will calculate a weighted index to map relative capacity and actions using a color gradient. The anticipated results will be conveyed through a digital map, which will be equipped with layers showing the existence of food system objectives and positions in their respective county or municipality. The map can be utilized as an online resource for county and municipality governments, as well as NGOs, civic action groups, and residents both within and outside of the Central Appalachian region.

Mentor(s): Lia Kelinsky-Jones, Agricultural, Leadership, and Community Education, Virginia Tech

Bamlak Sebil
Virginia Tech/Cyber Management and Analytics

Expertise Retrieval and Scoring Algorithm

The Expertise Retrieval and Scoring Algorithm (ERSA) represents a transformative advancement in the evaluation of professional expertise, addressing the limitations of traditional methodologies such as graph-based, reputation-based, and document-based systems. By combining advanced Natural Language Processing (NLP) techniques, Named Entity Recognition (NER), and multi-dimensional scoring metrics, ERSA facilitates precise and scalable expertise evaluation. This study demonstrates ERSA's ability to parse and score corporate biographies, with a specific focus on cybersecurity expertise, using a hybrid approach that integrates methods like BM25, Cosine Similarity, ColBERT, and Cross-Encoder models. ERSA's data extraction methods, normalization, and scoring processes minimize biases and inaccuracies associated with manual or single-metric evaluations. The findings reveal ERSA's adaptability across domains and its potential to streamline decision-making in areas with heterogenous filing and ambiguous data sets. By automating the retrieval and scoring of unstructured data, ERSA provides actionable insights, bridging the gap between organizational strategy and expertise evaluation. This paper highlights ERSA's contributions, challenges, and future research directions, underscoring its relevance in the growing landscape of organizational research.

Mentor(s): Joseph Simpson, Business Information Technology, Virginia Tech

Shivansh Shah
Virginia Tech/Robotics and Mechatronics
Viswajit Talluru
Virginia Tech/Aerospace and Oceans Engineering

EXPERIMENTAL EVALUATION OF PIEZORESISTIVE SENSING BEHAVIOR IN MWCNT-PBEs UNDER ELEVATED TEMPERATURE CONDITIONS

This experimental investigation aims to gain insight into the strain and damage-sensing capabilities of binders containing ammonium perchlorate (AP) and multi-walled carbon nanotubes (MWCNTs) under thermal loading. Self-sensing behavior is achieved by incorporating MWCNTs into the binder system, where networks of MWCNTs exhibit piezoresistive behavior when subjected to compressive loading. Polydimethylsiloxane (PDMS), an elastomer, is a commonly used binder in polymer-bonded energetic materials. The addition of MWCNTs enhances the sensing abilities of the material by forming conductive networks. Exploratory results demon- strate that AP-CNT 1% PDMS and AP-CNT 2% PDMS (ammonium perchlorate–multi-walled carbon nanotube–polydimethylsiloxane systems) exhibit effective sensing capabilities due to these conductive networks, while samples without CNTs (AP-PDMS) does not have any sensing capacity. When the samples are placed in an environmental chamber and heated to 80◦C , their electrical resistance increases. However, a significant drop in electrical resistance is observed when the samples are held at this temperature. Upon cooling the samples to room temperature by introducing liquid nitrogen into the chamber, the electrical resistance increases again. These findings indicate that polymer-bonded energetic materials with MWCNTs are capable of sensing thermal changes, as demonstrated by their response to elevated temperatures and subsequent cooling to room temperature.

Mentor(s): Gary Seidel, Aerospace and Oceans Engineering, Virginia Tech

Stella Shallard
Virginia Tech/Biochemistry
Ladan Ahmed
Virginia Tech/Biochemistry

The Use of High Resolution Mass Spectrometry and Liquid Chromatography for the Identification of Compounds

In our research using Virginia Tech's mass spectrometry incubator (VTMSI), the objective is to confirm the identities of the compounds that laboratories in the Blacksburg area believed to have synthesized. The mass spectrometry software has various tools that aid in the analysis process. For example, we can produce theoretical isotope models of a given compound using the expected molecular formula, and compare it against the experimentally produced peaks, which allows for a purity assessment and identity confirmation.

This machinery provides high accuracy results, with results only deviating a maximum of 3 parts per million (ppm) from the actual molecular mass. The purpose of this research is to ensure that the compounds submitted for analysis are pure and match that of the intended molecular formula. While undergoing this research, we are also simultaneously gaining laboratory skills in software use and maintenance, microdilutions, and biochemical calculations. Through microdilutions, we can create 1 mL samples that have the optimum concentration for the mass spectrometer (0.01 mg/mL), which allows for clear and defined peaks for interpretation. Our project outcome aims to explain how we are able to use software and machinery to analyze sample submissions as well as explain the importance of mass spectrometry and liquid chromatography in modern research.

Mentor(s): Sherry Hildreth, Mass Spectrometry, Virginia Tech

Kylie Simms
Virginia Tech/Public Health
Emma Knox
Virginia Tech/Biochemistry
Jahnavi Guddeti
Virginia Tech/Biology

Effect of Various Air Quality on Virginia Tech Students' Health

High levels of air pollution and particulate matter are associated with 6.7 million premature deaths annually. Virginia Tech's campus is a sprawling area with open spaces, residential halls, dining facilities, agriculture spaces, academic buildings, offices, bus stops and more. Therefore, we aimed to identify what areas on Virginia Tech's campus did not meet the World Health Organization (WHO) guidelines for good air quality and how bad air quality might affect students' physical health. We used a Temtop Model Air Quality Meter to collect various air quality parameters through the machine's sensors. We hypothesized that since buildings on campus are close together, pollutants are often trapped between them, leading to higher concentrations. We found that residential halls had higher health risks to inhabitants from the levels of particulate matter (PM2.5) that we measured, likely from shared ventilation systems and higher occupancy in these buildings compared to shared classrooms on campus. Furthermore, dining and outdoor areas exhibited high levels of particle concentration due to emissions and air pollutants. Increasing the amount of open spaces between buildings and reducing emissions from the number of vehicles around campus would result in lower pollutant concentrations than buildings in row, improving air quality. We hope that our findings may eventually contribute to the development of better air quality levels and an improvement in students' health on campus.

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

Jaime Simson
Virginia Tech/Biochemistry

Wheat-ness the Change: Sowing the Seeds of Regeneration

Modern agriculture faces multifaceted challenges posed by climate change, and biodiversity loss, which exacerbates global food insecurity. These problems can be addressed in part through bioengineering crops with gene-editing tools such as CRISPR. However, the application of these tools requires the regeneration of an entire edited plant, and these protocols are crop species specific. Wheat is a staple crop around the world and recalcitrant to standard transformation and regeneration protocols. In this study we investigate whether elite Virginia Tech cultivars can be genetically modified (transformed) and regenerated. Our regeneration and transformation process involves transforming leaf sections with Agrobacterium and regrowing an entire plant from the transformed cells. We have optimized our protocol through many rigorous tests such as testing the regeneration efficiency between different sections of tissue on the plant, as well as the differences between different elite cultivars. A two-way ANOVA was used for statistical analysis. While we are still optimizing the wheat transformation protocol, we have been successful in Arabidopsis (a model organism) transformation with the same DNA vector. These processes are stressful for the plants. To ensure our plants are genetically similar to the parent plants, we checked for changes in the genome size of the regenerated plants. Overall, our regeneration protocol has been successful, and we are working toward a successful transformation protocol. Our methods will enable efficient application of bioengineering tools in wheat, contributing to a solution towards global food security.

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

Ann Sisson

Virginia Tech/Animal and Poultry Sciences

Effects of dietary energy and emulsifier on the performance and energy storage of pullets and young laying hens

The renewable fuels standards current focus is to increase the conversion of renewable oil sources into biodiesel. This loss of oil to the transportation sector will place pressure on dietary energy creating opportunities for alternative technologies such as emulsifiers. Emulsifiers act to stabilize the interaction between hydrophobic and hydrophilic fractions, increasing the digestibility of lipids and increasing dietary energy extraction. An experiment was conducted to determine the effects of an emulsifier supplemented to 15–45-week-old laying hens fed two concentrations of dietary energy. The 6 dietary treatments were provided to 16 replicate cages of 3 laying hens. Response criteria included: egg production, feed intake, feed conversion ratio (FCR), and internal and external eggshell quality determined over the duration of the experiment. At the end of the experiment, body weights abdominal fat pad weights were determined to indicate energy storage efficiency. Egg production was not altered by dietary treatment, although increased dietary energy resulted in increased egg size, reduced feed intake and FCR. The response of the emulsifier was more complex, the 250 ppm allowed laying hens to maintain their body reserves (body weight and abdominal fat pad weights) similar to those of the higher energy diet and significantly increased in comparison to the hens fed the lower energy diet without emulsifier and the 500 ppm treatment did not respond.

Mentor(s): Michael Persia, School of Animal Sciences, Virginia Tech

Lindsay Smith

Virginia Tech/Microbiology

Engineered Commensal Bacteria to Confer Protection Against Enteric Pathogens

Salmonella enterica serovar Typhimurium (STM) and Enteritidis are the causal agents of Salmonellosis, a leading foodborne illness in the U.S.. The rise of antibiotic-resistant STM clinical isolates has highlighted the need for prophylactic approaches and complementary strategies to treat STM infections. Bacteriophages (phages) offer promise against enteric pathogens, but challenges with efficacy and oral delivery limit clinical application. We engineered a commensal E. coli strain carrying the heterologous P22 prophage to prevent STM propagation in the gut. The lysogen was modified with the P22 phage repressor gene to ensure stable prophage integration while enabling activation of the lytic cycle upon STM infection, leading to targeted pathogen eradication. Additionally, the engineered E. coli expressed a DNA methylase gene, allowing the P22 phage to bypass STM defense systems. In co-culture, STM was reduced to undetectable levels after 8 hours of incubation with the lysogenic E. coli, whereas STM grew substantially in the presence of non-lysogenic E. coli or free phage particles alone. These findings indicate that both phage predation and bacterial competition are essential for effective pathogen clearance. In an STM-induced colitis mouse model, treatment with the engineered E. coli maintained stable P22 levels in the gut and extended mouse survival compared to controls treated with the non-lysogenic strain. Our results demonstrate the potential of engineered commensal bacteria as effective phage delivery vehicles to control enteric pathogens and offer a promising complementary strategy against antibiotic-resistant STM infections.

Mentor(s): Rogerio Bataglioli, Biological Sciences, Virginia Tech

Mayank Sood
Virginia Tech/Packaging Systems and Design
Mateo Silva
Virginia Tech/Packaging Systems and Design
Kevin Song
Virginia Tech/Packaging Systems and Design

Impact of Relative Humidity on the Thermal Efficiency of Fiber-Based Insulated Shipping Containers

This study investigates how relative humidity influences the performance of fiber-based insulated shipping containers (ISCs) used in cold chain logistics. The research addresses a critical gap in current testing protocols such as ASTM D3103 and ISTA 7D/7E, which overlook humidity as a variable affecting insulation. Our primary objective is to quantify the effect of humidity on the thermal resistivity and overall thermal performance of various insulation materials—both fiber- and polymer-based—across different temperature and humidity conditions.

We evaluated seven ISC configurations using standardized shippers, gel packs, and payload boxes in controlled environmental chambers. Insulation types included corrugated board, honeycomb fiberboard, expanded polystyrene, and polyurethane foam. Materials were conditioned, packed with temperature sensors, and tested until internal temperatures exceeded 8°C. Thermal resistivity was assessed using ASTM C518-compliant methods.

Results show that higher relative humidity significantly reduces thermal performance in fiber-based materials, with performance time decreasing by 15–17% between 30% and 80% RH. However, polyurethane foam was not significantly affected. The inclusion of propylene glycol-filled payloads improved test realism and reinforced the humidity-performance relationship. These findings highlight the need for humidity-inclusive testing protocols to enhance reliability and accuracy in cold chain packaging validation.

Mentor(s): Eduardo Molina, CNRE Packaging, Virginia Tech

Laura Speaks
Virginia Tech/Forestry

Assessment of Red Spruce Encroachment into Areas of Hemlock Decline at Mountain Lake

The Mountain Lake area within the George Washington-Jefferson National Forest provides the unique climatic conditions and appropriate elevation that facilitates the growth of red spruce (Picea rubens). Numerous stands in this locality have been impacted by spongy moth (Lymantria dispar) infestations, and its eastern hemlock (Tsuga canadensis) is in drastic decline due to the hemlock wooly adelgid (Adelges tsugae). The decrease of hemlocks in this region, who share similar habitat requirements and are often in competition with red spruce, creates an opportunity for red spruce to expand into areas dominated by hemlock prior to the hemlock wooly adelgid. As well, the red spruce may be expanding into other recently disturbed nearby areas. This research aims to assess the extent, if any, of red spruce encroachment into areas of hemlock decline and elsewhere at Mountain Lake. To investigate this hypothesis, the current distribution of red spruce and hemlock within designated areas of Mountain Lake would be quantified and mapped, with particular consideration given to younger stems and areas of regeneration. Abiotic factors that potentially influence new red spruce growth and intrusion, such as aspect, slope, and other site characteristics would be considered. Evaluating the extent of red spruce encroachment and the sustainability of this potential expansion will assist in the understanding of forest dynamics in response to recent disturbances within the Mountain Lake ecosystem.

Mentor(s): Corey Green, Forest Resources and Environmental Conservation, Virginia Tech

Ezra Staengl
Virginia Tech/Wildlife Conservation

Classification of Piedmont Grassland Plant Communities

The grasslands of the Virginia Piedmont are species rich and ecologically important but imperiled and poorly studied. Many of the remaining grasslands in the region are small fragments in artificially disturbed habitats, such as powerline rights-of-way. To more effectively conserve and restore these fragments, it's necessary to understand their floristic composition and environmental variation. Additionally, it’s important to characterize their similarity to the few grasslands in Virginia that persist under a semi-natural disturbance regime. To accomplish these goals, we collected floristic composition, soil chemistry and texture, and other environmental data from 218 plots in the Piedmont of Virginia. We added plots from the Virginia Department of Conservation and Recreation (DCR) Natural Heritage Program’s Piedmont Oak - Hickory Woodlands, Savannas, and Grasslands group to the dataset before analysis. We then used hierarchical agglomerative clustering, nonmetric multidimensional scaling ordination, indicator species analysis, and individual comparisons of 13 environmental variables to characterize floristic types and their relationship to the environment. Our cluster analysis showed support for 8 grassland types. DCR plots generally clustered with our upland grassland plots, offering support that despite their small size our plots are high quality grasslands with similar floristic composition to the best remaining examples in Virginia. These biodiverse grassland fragments are widespread in the Piedmont, and many have not yet been inventoried. Thus, they are in urgent need of further study and protection.

Mentor(s): J. Leighton Reid, School of Plant and Environmental Sciences, Virginia Tech
Jordan Coscia, School of Plant and Environmental Sciences, Virginia Tech

Emily Steinbach
Virginia Tech/Psychology
Kiryn Virdi
Virginia Tech/Psychology
Anthony Laub
Virginia Tech/Biological Sciences
Anya Merriman-Mix
Virginia Tech/Psychology

Exploring Determinants of Psychological Safety in Higher Education

Psychological Safety (PS)—the degree of personal inclusion, contribution, and engagement one experiences in given situations—has become a popular issue in industrial settings. However, PS has not been studied in educational settings. This research examined students' perceptions of PS in various college courses with an innovative 51-question survey. A total of 169 students provided answers for this survey, each responding with reference to a university course taken within the past year. This questionnaire assesses PS with an eight-question "Psychological Safety in Education" scale, adapted from PS scales used for industrial settings. Our PS scale assesses students' perceived PS by asking them to respond to eight statements on a 7-point Likert Scale. Average Psychological Safety Scores (APSS) varied as a function of the specific class the student evaluated and were influenced by other factors. The systematic analysis of the PS data indicated that student's felt more psychologically safe when they could identify with others on more than one determinant in the class ($p=0.0101$). Other significant determinants of PS were: a.) the student's evaluation of the professor ($p < 0.001$), b.) student's evaluation of the course ($p < 0.001$), c.) and student's attendance in the course ($p=0.0494$). These findings suggest that peer connection and classroom experiences play critical roles in students' average psychological safety scores. This study was limited by the potential inaccuracy of students' recall of the course they evaluated. Additionally, the limited diversity of majors reported may reduce the generalizability of the findings to the broader Virginia Tech student population.

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

Carmen Stevenson
Virginia Tech/Biological Sciences

Flowers in Flux: Shifts in Seasonal Blooming Times of Mertensia virginica

Climate change is shifting spring ephemeral plant phenology, causing them to bloom earlier than usual. This project focuses on the changing flowering and fruiting times of Mertensia virginica, or the Virginia bluebell, over a period of 23 years. The Virginia bluebell is native to the Appalachian region and can grow up to two feet tall, producing pink buds that open into light blue, bell-shaped flowers. Additionally, it has both culinary and medicinal uses; the leaves and stems are often eaten when boiled, and indigenous tribes used it as a pulmonary aid, a tuberculosis treatment, and a poison antidote. I analyzed trends in phenological activity using images of herbarium records and citizen science data collected from iNaturalist and GBIF, as well as local weather and climate data. These images included scanned copies of preserved herbarium specimens as well as observations made by citizens. iNaturalist allows amateurs to contribute to its database by taking pictures of plants they spot in nature and uploading them to the website. I scored these images of the species on a 0-4 scale based on their observed phenophases. The results will show that the Virginia bluebell's blooming times have shifted earlier in the year in correlation with rising global temperatures. Topics for future research include how phenological shifts could lead to pollinator mismatch, a phenomenon caused by asynchronous flowering times and pollinator activity periods that can lead to plant reproduction failure.

Mentor(s): Jordan Metzgar, Biology, Virginia Tech

Aniya Stewart
Virginia Tech/Microbiology

Development of Novel Diagnostic Tools for Staphylococcus aureus Strains Causing Joint Infection

Staphylococcus aureus is a pathogenic bacteria causing infections in the skin and synovial joints of horses and humans, which have the ability to adapt to the synovial environment and alter their preferred carbon sources for growth. The primary carbon source for bacteria in synovial fluid is hyaluronic acid (HA), a polysaccharide that is a major component in the extracellular matrix of the joints and highly concentrated in the synovial fluid of synovial joints. The other components of synovial fluid like collagen and glucosamine also provide nutrients for the proliferation and biofilm forming capabilities of the bacteria. Diagnosing S. aureus caused joint infections is often difficult due to the nutritional environment that allows the bacteria to form biofilms that go undetected by traditional culture methods. When cultured with standard media like tryptic soy agar + 5% sheep blood (BA), the bacteria adapt to the new environment and form small colony variants (SCVs), which are difficult to identify. The adaptation of the bacteria causes alterations in their genome which alters their virulence type, increasing the difficulty of studying the phenotypes important for joint infections. To address this problem, we developed a biofilm dispersal protocol and a novel solid medium for isolation of these joint infection isolates that mimics the healthy synovial environment to support growth and preserve genotypic and phenotypic characteristics. Using clinical joint samples that had previously returned negative culture results, our novel solid media has increased colony size and overall growth of all S. aureus isolates identified as SCVs. Future work will involve collecting more samples and isolates to further validate our methods. We will examine the genomes of isolates grown in traditional media in comparison to our novel medium to determine how genotypes and associated phenotypes are preserved between media types. Imitating the joint environment without the use of actual synovial fluid will create a familiar environment primed to support the growth of S. aureus while reducing the cost, increasing accessibility, and allowing better diagnostic capabilities. This work is significant as we aim to develop a diagnostic kit to provide to clinicians to aid in the rapid diagnosis of biofilm-forming and fastidious joint pathogens to reduce time to appropriate treatment and improve patient outcomes.

Mentor(s): Jessica Gilbertie, Veterinary Medicine, Virginia Tech
Doug Pluta, College of Veterinary Medicine, Virginia Tech

Chloe Stockli
Virginia Tech/Cognitive Behavioral Neuroscience
Briana Ermanni
Virginia Tech/Psychology (grad student)

Maternal facilitation of attention at age 2 predicts inhibitory control at age 3

Maternal caregiving behaviors refers to the different ways in which a mother responds to her child's needs in a supportive and appropriate way, including showing positive affect and emotional expressions, as well as helping the child focus their attention without being too controlling (Perry et al., 2016). Other behaviors such as intrusiveness and high directiveness can interfere with a child's independence by not allowing them to make their own choices (Hudson et al., 2008). These caregiving behaviors can influence children's developing ability to inhibit behavior through scaffolding and developing autonomy (Frick et al., 2019). Therefore, the current study was interested in understanding how these different aspects of maternal caregiving behaviors are longitudinally related to children's inhibitory control. Maternal caregiving behaviors ($N = 240$; positive affect, facilitates attention, intrusiveness, directiveness, negative affect) were coded for in 30-second epochs during a difficult puzzle task (Perry et al., 2018). Inhibitory control ($N = 164$) was measured using the Day/Night task (Gerstadt et al., 1994) where children are shown pictures of the sun or moon and asked to say the opposite time of day (e.g., say "day" for a moon). Results of a stepwise regression model showed that maternal facilitation of attention at age 2 predicted better inhibitory control performance at age 3 ($B = 0.11$, $p = .03$). No other caregiving behaviors were predictive of inhibitory control at this age, which suggests that maternal influences on attention specifically may be most important for regulation at this age.

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

Gabriella Sullivan
Virginia Tech/Biology

The High Road: Cannabis, MYC2, and Trichome Formation

This study investigates the role of the MYC2 transcription factor in regulating trichome development and cannabinoid biosynthesis in Cannabis sativa 'Cherry Wine' using cell suspension and protoplast isolation techniques. Trichomes, the primary site of cannabinoid synthesis, exhibit enhanced development upon overexpression of CsMYC2, a gene found to be highly expressed within these structures. It is believed that CsMYC2 directly or indirectly controls key genes involved in cannabinoid production and trichome formation. A gene regulatory network is constructed by identifying direct and indirect targets of CsMYC2. Cell suspensions and protoplast isolations are utilized to isolate chloroplasts, allowing for the examination of the potential influence of CsMYC2 on chloroplast function within trichome cells. Flow cytometry is employed to analyze protoplast populations and assess transformation efficiency following PEG-mediated transformation. This would provide insights into the mechanisms in trichome development and cannabinoid biosynthesis, potentially leading to improved cannabinoid production in cannabis.

Mentor(s): Bastiaan Bargmann,TPSC, Virginia Tech
Adam Sumner, TPSC, Virginia Tech and NC State

Cole Sullivan-Fielding
Virginia Tech/Wildlife Conservation
Emory Harned
Virginia Tech/Fish Conservation

Assessing the seed-dispersal networks of common invasive fleshy-fruiting plants in Virginia

Invasive plants are a growing threat to ecosystems globally due to their proliferative nature and the ability to outcompete native species. Animal-mediated seed dispersal plays a vital role in maintaining native plant diversity and forest structure, however, generalist frugivores can spread invasive plants into native habitats. 27 fleshy fruiting invasive plants in Virginia's forests are likely dispersed by vertebrate frugivores. Our study aims to identify the primary consumers of fleshy-fruiting invasive plants and assess each frugivore's fruit-handling behavior and visitation rate across each plant species' entire fruit-ripening window. We conducted fieldwork at StReam Lab, a stream restoration site with riparian forest adjacent to open grass and agricultural areas from September–December 2024. We rotated 9 motion sensor Browning camera traps between a total of 34 individual plants belonging to 7 invasive fleshy-fruiting species of vines, shrubs, and trees. Camera traps recorded 30-second videos to capture fruit-handling behavior and frugivore visitation. We reviewed the footage in two rounds, the first one to determine which videos had visitors, and the second to determine which visitors were potential seed dispersers. Based on preliminary findings, we recorded 23 species of frugivores on invasive plants, 13 of which consumed invasive fruits. All frugivores were native. Upon completing the footage review we will use this data to construct a seed dispersal network between frugivores and invasive fruiting plants in this region. These results will help us gain better insight into which native species facilitate invasion, to inform better restoration and management strategies.

Mentor(s): Haldre Rogers,CNRE - Department of Fish and Wildlife, Virginia Tech
Abir Jain, CNRE Department of Fish and Wildlife, Virginia Tech

Natalie Szenas
Virginia Tech/Human Development

Validating Behavioral Tasks for Measuring Aggression and Prosociality Using Self-Report Measures

Recent research has explored the relationship between aggression and prosociality, highlighting the need for parallel task designs compatible with fMRI. To address this, our group adapted the Fight-or-Escape paradigm (Krämer et al., 2007) and developed a parallel, ecologically valid prosociality task to simulate real-life social behavior in the lab. This study aimed to examine the validity of these aggression and prosociality tasks by evaluating how behavioral responses relate to self-reported measures of aggression and prosociality. Participants completed the Aggression and Prosocial Behavior Questionnaire (APBQ), the Reactive-Proactive Aggression Questionnaire (RPQ), and the Buss-Perry Aggression Questionnaire (BPAQ).

A total of 86 participants (age range: 18-26 yr, M = 20.00±1.56; 52.3% Female) were included in this analysis. Results showed that higher RPQ scores, including reactive aggression and total aggression subscales, were significantly associated with increased task-related reactive aggression (r = 0.246, 95%CI = [0.053, 0.419]) and overall aggression (r = 0.243, 95%CI = [0.065, 0.419]). Similarly, higher BPAQ aggression sum scores were significantly correlated with greater overall aggression (r = 0.016, 95%CI = [0.054, 0.446]). However, scores on the APBQ reactive prosocial subscale were insignificantly correlated with task-related reactive prosociality (r = -0.929 , 95%CI = [-0.233, 0.242]) and task-related mean prosociality (r = -0.024, 95%CI = [-0.244, 0.219]).

These findings provide partial support for the task assessing aggression but suggest limited validity in capturing prosocial behaviors.

Mentor(s): Tae-Ho Lee, Psychology, Virginia Tech
Ya-Yun Chen, Psychology, Virginia Tech

Divyasimha Talreja
Virginia Tech/Computer Science

What the Fed Is Really Saying: Using AI to Analyze Speeches

Federal Reserve speeches are a crucial tool for communicating economic policy, often shaping financial markets, and influencing expectations. Understanding sentiment and risk assessments in these speeches offers early insight into macroeconomic outlooks, benefiting researchers and shaping policy narratives.

Analyzing Fed speeches is a challenge because of their volume, length, and degree of nuance. Existing approaches like keyword tracking and basic sentiment scores fail to grasp the broader narrative and shifting priorities within Fed communications. These methods lack context, overlook rhetorical choices, and miss the semantic meaning of language used in Fed speeches.

To address these issues, I collected over 1,200 speeches from the Federal Reserve website. I then processed them into overlapping, digestible segments and used an open-weights large language model (LLM) (Qwen-2.5-32B), to extract potential risk factors mentioned in the speeches. For verification, I manually analyzed a subset of speeches to establish a baseline for the model.

Initial results showed that the LLM reliably captured the same recurring concerns I had noted—inflation, labor market dynamics, and financial instability—and even highlighted themes I had overlooked. The model was especially effective at uncovering quantitative details, such as data points and forecasts, and used them to justify its reasoning.

Next steps include prompting the LLM with the curated data to generate sentiment profiles and simulate predictive outlooks. It will also be important to track how risk factors evolve and link them to external economic or geopolitical events. This project highlights generative AI's potential to analyze central bank communication at scale.

Mentor(s): Andrew Katz, College of Engineering, Virginia Tech

Bryanna Taylor
Virginia Tech/Criminology
Madison Fleming
Virginia Tech/Psychology

Correlation's Between the Passing of Erin's Law and Political Affiliations, Educational Funding Status, and Current Sexual Education Policies within each of the States in the U.S.

Childhood sexual abuse occurs at alarming rates in the U.S., particularly in children with intellectual and developmental disabilities (IDD). Abuse survivor Erin Merryn has championed "Erin's Law," allowing provision of school-based abuse prevention instruction. While Erin's Law deals with protection, it can be interpreted in some states as "sexual education;" thus 12 states have not passed it. Without education, many individuals with IDD lack knowledge about consent, sexual health, or abuse. To better understand the dynamics of sexual education in the U.S., we analyzed differences between states that have passed vs. not passed Erin's Law, examining potential predictors of the passage of this law including political affiliation, educational funding status, and the landscape of current sexual educational policies (abstinence, consent, goals on individualized education plans [IEP]). We found no significant difference in IEP goals between the groups of states ($\chi2$ (1) = 2.57, $p = .11$). No significant difference was found around abstinence being stressed by states ($\chi2$ (1) = .29, $p = .59$). We found a significant difference in whether consent was covered in states that have or have not passed Erin's Law ($\chi2$ (1) = 4.45, $p = .04$). There was no significant difference between political affiliation and whether the states have passed Erin's Law, but the p-value indicates a trend toward significance ($\chi2$ (1) = 3.05, $p = .08$). We are not seeing a significant difference based on education funding per pupil, but the p-value indicates a trend toward significance ($t(48) = -1.59$, $p = .06$).

Mentor(s): Chelsea Armour, Psychology, Virginia Tech
Jamie Edgin, Department of Psychology, Virginia Tech

Maxx Thalmann
Virginia Tech/Honors Quantitative Economics

Assessing the Impact of Chinese FDI on Inequality in Bolivia's Lithium Industry

My research question is as follows: How does Chinese Foreign Direct Investment in the Bolivian lithium industry affect inequality? Bolivia is home to some of the largest lithium reserves in the world, primarily stored in the Salar de Uyuni salt flat. Lithium is a crucial mineral for the production of batteries used in electrical vehicles, consumer electronics, renewable energy storage, and military technology. As the demand for clean energy has skyrocketed, the Bolivian lithium industry has become the target of foreign direct investment. China in particular has aggressively pursued access to Bolivia's vast lithium stores. It is estimated that China will generate the most revenue in the Battery Electric vehicles market, with a projected revenue of "$225.6 billion in 2025." China's investment in Bolivia's lithium industry is a part of the country's Belt and Road Initiative, an extremely important topic to Naval leaders and U.S. strategic interests as it details the economic growth and development of our near-peer adversary. The Belt and Road Initiative is an enormous infrastructure and development initiative aimed at strengthening China's economy and its foreign influence.

Theoretically, an economist could argue that Chinese investment increases inequality, relating this claim to the neo-colonial dependence growth model, which attributes continued under-development or stagnation to an international capitalist system of rich country domination over poorer countries; within poor countries, elites collude with, and are dominated by multinational corporations, as well as multilateral assistance organizations - World Bank, IMF, i.e. I plan to use the synthetic diff-and-diff regression model to test this hypothesis.

Mentor(s): Alexander McQuoid, Economics, Virginia Tech

Tessa Thibodeau

Virginia Tech/Biological Sciences

Virginia Tech Football Games and Their Impact on Illicit Drug Presence in Local Surface Waters

Illicit drugs in freshwater systems pose significant environmental and health concerns. These substances primarily enter water bodies through leaky infrastructure, human excretion, and improper disposal, bypassing conventional wastewater treatment processes. Their presence can disrupt aquatic ecosystems, thus affecting behavior, reproduction, and overall ecological balance. Contaminated water also raises potential health risks, as trace amounts of these drugs may persist in the drinking supply. Previous studies have shown that sporting events can introduce illicit drugs at higher concentrations and are typically expected. Thus, our research explores the occurrence of illicit drugs and their metabolites in surface water before and after Virginia Tech football games. Additionally, the study examines how factors such as game attendance, and varying weather conditions, including temperature and rainfall, affect contamination occurrence. We addressed this by collecting surface water from nearby streams before and after home football games. These samples underwent solid phase extraction, non-targeted LCMS/MS analysis, and using Mass Hunter analytes of interest were identified. The goal of this research was to gain a comprehensive understanding of how large sporting events and environmental variables interact to influence water quality in a college town.

Mentor(s): Austin Gray, Biology, Virginia Tech

Bailey Thomas
Virginia Tech/Animal Science

Organic vs Non-Organic Strawberry and Blackberry Polyphenol Content

Strawberries and Blackberries are among the most widely consumed fruits in the United States, because of their rich, sweet flavor and potential health benefits. These benefits are due to both berries' high polyphenol content. Polyphenols are natural antioxidants that contribute to both the vibrant colors and health benefits of berries. This study aims to investigate how phenolic content varied across different strawberry and blackberry samples, with the goal of identifying those with the highest antioxidant levels to promote health. To assess phenolic content, thirteen samples were analyzed. The berries were lyophilized and homogenized prior to phenolic extraction with an acidified methanol-water solution. Total polyphenol content was quantified via the vitamin C corrected Folin Ciocalteu assay. Total monomeric anthocyanins (TMA) were measured via the pH differential assay. Total polyphenols in blackberries ranged from 34.8 to 38.3 mg GAE/g(dw) and in strawberries from 17.0 to 47.4 mg GAE/g(dw). TMA in blackberries ranged from 14.8 to 29.8 mg C3G/g(dw) and in strawberries from 1.04 to 5.08 mg C3G/g(dw). These findings are significant because they show no consistent relationship between organic berries and higher polyphenol content. In some cases, the non-organic samples had more polyphenols, indicating that organic berries likely have similar phenolic content to conventionally grown berries.

Mentor(s): Dennis Cladis, Food Science and Technology, Virginia Tech

Keegan Trubenbach
Virginia Tech/Civil Engineering
Sai Ashraya Chegu
Virginia Tech/Civil Engineering/Environmental Engineering

The Implementation of Passive Sampling for Aquifer Microbial Risk Assessment

Technologies such as managed aquifer recharge (MAR) and bioremediation promise to play an influential role in addressing water storage and water quality concerns that come 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 useful tool to monitor microbes in a manner that represents their in-situ state within an environmental setting. Our objective is to design a 3D printable sampler which can capture and accurately reflect the microbial communities present within an aqueous influent overtime. This sampler allows for collection of multiple samples simultaneously, while ensuring that other samples are not contaminated by environmental factors during sampling. We also performed 16S rRNA gene amplicon sequencing to compare the differences microbial communities captured by different sampling media, including laboratory sand, aquifer sediment, and zirconia beads. Results revealed that microbial communities recovered by the three media differed in Shannon diversity and taxonomic structure. This research indicates that the choice of sampling media in passive samplers play a key role in the diversity and composition of the microbial communities captured, benefiting the development of experimental tools needed for microbial risk monitoring in MAR.

Mentor(s): Jingqiu Liao, Charles E. Via, Jr. Department of Civil and Environmental Engineering, Virginia Tech
Amy Pruden, Charles E. Via, Jr. Department of Civil and Environmental Engineering, Virginia Tech

Hunter Tufarelli
Virginia Tech/Psychology

Creating accessible and affordable resources to empower self-identification and self-advocacy in neurodivergent adolescents.

There is a current need for creating accessible and affordable resources to encourage and empower self-identification and self-advocacy in neurodivergent youth. The goal of this project is to work on the creation of self-identification materials and eventually promote self-advocacy through providing middle and high-school counselors with the resources to guide students through self-identification. Current online self-assessment frameworks are not ideal and often created without consulting autistic people. Self-identification increases self-acceptance, which then promotes better self-advocacy. Teenagers able to self-identify as neurodivergent have a higher chance of being able to live life without the stress of masking, which leads to higher quality of life. There are more resources for autistic children than there are for autistic teens and young adults, which leads to this project's target. School counselors don't have sufficient training to help guide teenagers towards self-identification if approached with questions related to neurodivergence. Schools have limited budgets, some districts being "low-income areas", and many kids do not have an at-home support system; this project aims to bridge the gap for kids with less resource access. This project will begin by selecting widely used self-report autism questionnaires, recruiting a consultant team of autistic individuals from the general population, starting a peer-review process with the consultants, and eventually create a self-assessment booklet for students and a training guide booklet for counselors. The expected outcome of this project would be equipping (focused on, but not limited to) low-income schools with assessment resources for guiding neurodivergent teenagers towards neurodivergent self-awareness and promoting self-advocacy.

Mentor(s): Lavinia Carmen Uscătescu, Psychology, Virginia Tech

Elizabeth Van Order
Virginia Tech/Microbiology

Co-aggregation of skin microflora with Pseudomonas aeruginosa biofilms

Pseudomonas aeruginosa is the second most common organism isolated from chronic wound infections. Chronic wounds infected with P. aeruginosa are associated with larger wounds and delayed healing than those without. Skin commensals are often isolated from clinical chronic wound samples, and evidence suggests that commensal bacteria can impact the pathogenesis of infecting bacteria. However, the role of skin commensal bacteria to infection outcomes is still unclear. Therefore, this study aimed to develop a polymicrobial biofilm community of P. aeruginosa and Staphylococcus epidermidis and Corynebacterium striatum, two skin commensals commonly isolated from infections, and to analyze the microbial interactions of this mixed community.

To analyze these interactions, we developed an in vitro wound model where wound-like media is solidified with collagen. This model mimics both the structural and nutritional host environment, allowing for visualization of biofilm-aggregates by microscopy. The in vitro wound model was inoculated, and biofilm-aggregates grown for 6 and 24h. At 6h there is minimal penetration of the bacterial species into the model. By 24h, we observed that there is co-aggregation between the three species, suggesting that there may be co-biofilms forming during chronic wound infections. Further experiments includes: 16S sequencing, quantification of the species by colony forming units, and the addition of an artificial exudate media to become more nutritionally similar to the host environment.

Mentor(s): Erin Gloag, Department of Biomedical Sciences and Pathobiology, Virginia Tech

Sriniketh Vangaru
Virginia Tech/Computer Science

To pack or not to pack: Revisiting protein side-chain packing in the post-AlphaFold era

Motivation: Protein side-chain packing (PSCP), the problem of predicting side-chain conformation given a fixed backbone structure, has important implications in modeling of structures and interactions. However, despite the groundbreaking progress in protein structure prediction pioneered by AlphaFold, the existing PSCP methods still rely on experimental inputs, and do not leverage AlphaFold-predicted backbone coordinates to enable PSCP at scale.

Results: Here, we perform a large-scale benchmarking of the predictive performance of various PSCP methods on public datasets from multiple rounds of the Critical Assessment of Structure Prediction (CASP) challenges using a diverse set of evaluation metrics. Empirical results demonstrate that the PSCP methods perform well in packing the side-chains with experimental inputs, but they fail to generalize in repacking AlphaFold-generated structures. We additionally explore the effectiveness of leveraging the self-assessment confidence scores from AlphaFold by implementing a backbone confidence-aware integrative approach. While such a protocol often leads to performance improvement by attaining modest yet statistically significant accuracy gains over the AlphaFold baseline, it does not yield consistent and pronounced improvements. Our study highlights the recent advances and remaining challenges in PSCP in the post-AlphaFold era.

Availability: The code and raw data are freely available at https://github.com/Bhattacharya-Lab/PackBench.

Mentor(s): Debswapna Bhattacharya, Department of Computer Science, Virginia Tech

Dhruv Varshney
Virginia Tech/Computer Science

Smart Environmental Monitoring: An AI-Driven Approach to Watershed Data Integration and Access

This research addresses the challenge of efficiently accessing the extensive environmental data and research outcomes generated by the Learning Enhanced Watershed Assessment System (LEWAS) Lab at Virginia Tech over the past decade. Briefly, the LEWAS lab monitors high frequency water and weather parameters on VT campus. We developed an AI-powered chatbot using Retrieval-Augmented Generation (RAG) technology that converts the research output into searchable vector embeddings, enabling interactive access to complex environmental data. The system was enhanced to retrieve live sensor data on command, providing users with real-time information. The chatbot is already assisting with initial phases of the lab's planned migration to Amazon Web Services (AWS) by serving as a knowledge repository during the transition. Demonstrated to engineering students and evaluated by faculty researchers, the chatbot has proven effective at explaining complex environmental phenomenon like an acute chloride toxicity event in the watershed. Future development goals include expanding the chatbot's knowledge base to comprehensively document the AWS cloud infrastructure transition—making it easier users to understand the new system architecture—as well as personalizing information delivery based on users' academic level and expertise (high school students, undergraduates, or discipline-specific researchers), and integrating previously inaccessible environmental anomaly data from across Virginia Tech's campus. This research demonstrates how AI systems can transform environmental data accessibility while supporting infrastructure modernization, with applications extending to other environmental monitoring contexts. A journal paper documenting this implementation is currently in development, furthering the project's academic impact. Live demonstration of the LEWAS chatbot will be provided at the conference.

Mentor(s): Vinod Lohani, Engineering Education, Virginia Tech

John Venino
Virginia Tech/Geoscience

Grain Size Analysis of Pleistocene Turbidites and Ice-Sheet Interactions, IODP Expedition 400, Northwest Greenland Margin

This study utilizes Cenozoic sedimentary sequences obtained from the International Ocean Discovery Program (IODP) Expedition 400 to investigate climate and ice-sheet interactions in approximately the past 5 million years. Sediment cores were drilled at 6 different sites across the Northwest Greenland margin in Baffin Bay, however this study focuses on sites U1603 and U1604. These specific sites are Pleistocene age (past ~2.5 million years) oceanic slope to basin deposits. Within the cores obtained from those two drill sites, 160 samples with coarser grains deposited in the basin have been selected as they are possible representations of past turbidity currents. High-precision subsampling of these sediment samples with various sharp edges and metal instruments has allowed us to isolate the coarser grains of these turbidite sequences. Preliminary results through particle size analysis of 11 of these samples indicate that the interpreted turbidite layers range from coarse silt to just under coarse sand. This suggests a large range of turbidity current magnitudes. We anticipate that further grain size analysis will help us discover trends and relationships in grain size, bed thickness, and indications of past climate and glacial interaction of the Greenland Ice Sheet.

Mentor(s): Brian Romans, Geoscience, Virginia Tech
Faizan Sabir - PHD Student, Geoscience Department, Virginia Tech

Kristupas Vorobjovas
Virginia Tech/Biochemistry

Glutamine influence on uptake of amino acids in Arabidopsis thaliana

Amino acid homeostasis is critical for plant growth and survival, however excess levels of individual amino acids can disrupt cellular metabolism and lead to growth inhibition. It has been postulated that the toxicity arises from the way amino acid pathways are feedback regulated by amino acid themselves. Gln has been shown to alleviate amino acid toxicity, but the precise mechanism remains unknown. The hypothesis to be tested here was whether the addition to excess concentration of Gln competes with the uptake of the toxic amino acid, thereby reducing their toxicity. Arabidopsis seedlings were grown under axenic conditions and treated with varying concentrations of toxic amino acids with or without Gln. Uptake assays were performed using 3H-labeled glutamine, valine, and leucine to assess changes in transport activity and potential metabolic regulation. Current results showed that Gln slightly inhibits the uptake of the toxic amino acid, but the magnitude of the decrease could not account for the complete suppression of toxicity. An alternative hypothesis is that glutamine stimulate the TOR pathway, thereby altering amino acid metabolism, and overcoming the feedback regulation. The results provide insights into the regulatory mechanisms relating to amino metabolism and may offer methods for crop resilience and nutrient efficiency in the field.

Mentor(s): Guillaume Pilot, School of Plant and Environmental Sciences, Virginia Tech

Brianna Wade
Virginia Tech/English

Changes in Utilization of the Fillers Like, Um, and Uh Across Generations

Fillers are words or short phrases, um, uh, you know, like, etc., that can act as interjections or signs of pause during speech. Fillers can often signal a turn or that a speaker is planning their next utterance. Due to much discourse surrounding how certain fillers are utilized within certain generations, and how they are changing between these generations, with like commonly being a marker of younger individuals' speech (D'Arcy 2007), this research seeks to understand these generational changes. 14 speakers' conversational recordings, ranging across four generations and two locations, were utilized through the Corpus of Regional African American Language (CORAAL). Instances were recorded of the specified fillers uh, um, and like alongside how they were used, in a free-flowing sentence or standing on their own, and their preceding and following length of pause if applicable. Findings show an increase in the usage of like as a filler amongst younger speakers, while a similar trend can be seen for the increase of usage of um in older speakers while it is decreasing in younger speakers. There is an overall decline of the usage of um and uh in younger speakers, with a slight increase in uh utilization for speakers 30 and older that then stabilizes. In addition, there were significant statistical findings regarding male speakers' usage and when the filler was utilized standing alone. Despite the limitations of the sample size, this research further supports the ideology that filler words are changing with age, with like being a prominent feature of younger speakers' language.

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

Rabihah Waheed
Virginia Tech/Political Science

The United Nations and global governance: an investigation of genocide response by the UN and the influence of the top 5 powerful nations.

The United Nations (UN) was established in 1945 to help promote international peace and security, yet its effectiveness in responding to genocides has been questionable. For example, the Rwanda Genocide was unsuccessful because the UN was not able to act quickly enough, leading to over 1 million people dying. This research explains the role of the United Nations in addressing and reacting to genocides while focusing on the permanent 5 members, the United States, China, Russia, the United Kingdom, and France. The approach will include comparing and contrasting outcomes of the strategies implemented by the UN. This includes examples like the successful peacekeeping operations in Cambodia in 1950 and the unsuccessful events that led to the Bosnian genocide that caused over 8,000 deaths. I will further explore the limitations of the UN, which includes veto powers for 5 member countries, and its impact on intervention. The research displays the influence of the UN's ability to respond to genocide events effectively and promptly. Overall, the study will allow me to evaluate different approaches to restructuring the UN and highlight the complexities of international intervention that can have a broad impact. I will further be able to investigate the UN’s role in global governance and uphold its legitimacy in humanitarian crises.

Mentor(s): Nikki Lewis, Honors College, Virginia Tech
Bikrum Gill, Political Science, Virginia Tech

Elizabeth Wales
Virginia Tech/Psychology

Jane Cassidy
Virginia Tech/Biochemistry

Michaela Hegarty
Virginia Tech/Clinical Neuroscience
Annaliese Sutton
Virginia Tech/Psychology
Chanie Jacquemond Pallares
Virginia Tech/Clinical Neuroscience

Two-Year-Olds' Socioemotional Competence Predicts Expressive Vocabulary

Our lab investigates factors related to infants' and toddlers' emerging language skills, such as multisensory functioning, parenting practices, and socioemotional behaviors across the first years after birth. Here, we examined relationships between 2-year-olds' parent-reported socioemotional profile (ITSEA) and the number of words the toddlers regularly express (MCDI). The ITSEA is a useful survey that indicates a toddler's functioning in four distinct domains: externalizing behavior (e.g., aggressiveness), internalizing behavior (e.g., shyness), dysregulation (e.g., problems sleeping), and competence (e.g., showing empathy). At least one previous study found that 18-month-olds showing signs of language delay went on to score in the clinical range on the ITSEA – especially in the domain of competence.

We collected ITSEA and MCDI data from 34 two-year-olds as part of a longitudinal study of multisensory integration and language development. Using bivariate correlations and linear regression, we found that expressive vocabularies were positively correlated only with competence (r=+.57, p=.001), and that only competence significantly predicted the MCDI (model R2=.62, β=.62, p=.001). We also correlated the MCDI and six domains of the competence subscale (compliance, attention, imitation, mastery motivation, empathy, prosocial behavior) ~ only compliance (r=+.34, p=.05), imitation (r=+.42, p=.01), empathy (r=+.49, p=.005), and prosocial behavior (p=.44, p=.01) were significant.

These findings raise the possibility that social competence and word learning are bidirectionally related. That is, children with better language skills show more social competence and children with better social competence show higher expressive language. Future studies can help better understand this bidirectionality and whether parenting behaviors influence both skills.

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

Alexandra Watson
Virginia Tech/Animal & Poultry Science

Grief and Aging in Companion Dogs: Social Loss and Its Effects

This research investigates how dogs experience loss, whether through the death or departure of a human or animal companion, and how these losses impact their aging. Using data from the Dog Aging Project (DAP), a nationwide longitudinal study involving tens of thousands of dog owners, this project aims to understand the effects of grief and social disruption on a dog's wellbeing. The broader goal of this study is to enhance the current understanding of dog health after a social transition and to develop supportive strategies that can help enhance a dog’s wellbeing following the loss of a companion, especially given the limited existing research on how dogs respond to these disruptions. We developed a guide for conducting semi-structured interviews during which we will explore how dog owners perceive their dogs’ emotional lives and responses to loss. The interviews aim to identify behavioral changes, assess the nature of dog-companion relationships, and examine interventions or resources used, highlighting potential gaps in veterinary support. Interview data will inform the development of an extensive grief and loss survey, to be analyzed alongside responses from DAP’s Annual Follow-Up Survey which includes data on individual dog health outcomes (N=47,444). The anticipated outcome of this research is to advance the current understanding of the impact of grief on dogs, contributing to improved veterinary care practices and expanded empathy toward animals’ emotional experiences.

Mentor(s): Audrey Ruple, Population Health Sciences, Virginia-Maryland College of Veterinary Medicine
Courtney L. Sexton, Population Health Sciences, Virginia-Maryland College of Veterinary Medicine

Quinn Weigel
Virginia Tech/Biology

Impacts of Tropical Storm Helene on Benthic Macroinvertebrate Assemblages in Central Appalachian Headwaters

In late September 2024, Hurricane Helene, a powerful Category 4 storm, made landfall in southern Florida before weakening into a tropical depression as it moved northward. The storm brought torrential rainfall and catastrophic flooding across the Southeastern United States, culminating in a record-breaking four-day rainfall period that severely impacted Central Appalachia. With freshwater streams being a central subject of this destruction, the severity of their ecosystem's impact and prospective recovery necessitates assessment. This assessment finds and tests the significance in the immediate shift of benthic macroinvertebrate diversity and abundance in Central Appalachian headwater streams due to tropical storm Helene. To perform this, data from nine Virginian and West Virginian headwater streams included in or adjacent to the affected region was analyzed. Stream gauges reported various surges in water level per each site. Using Surber sampling, quantitative data from aquatic benthic insects was collected monthly at three sites and quarterly at six sites, with five replicates spanning each stream's reach. These streams were located in multiple watersheds across a wide salinity gradient where specific conductivity ranged from 19-1,185 µS/cm. This sampling produced a full prior season of unaffected macroinvertebrate population data to act as a baseline of species richness and abundance, with the site variety of watersheds possibly enabling analysis through a Before-After Control-Impact design. Our preliminary analysis has thus far indicated a significant and immediate decline of benthic macroinvertebrate total abundance and genus richness due to Hurricane Helene, with further analysis expecting to investigate the later recovery months, biomass fluctuation, and connecting water level data with severity of impact. Though headwater ecosystems are known for their constant change, their stability is very precious for supporting increasingly rare insect taxa. The resilience of these organisms is paramount to their conservation, and storm surges such as Helene's may provide insight on the extent of this resilience. Subsequently, identification of threat and disturbance is crucial, making the full understanding of Hurricane Helene's effect needed, especially when considering the inland impact of extremified tropical storms and the subsequent ecological recovery from them.

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

Sydney-Riley Whittaker
Virginia Tech/Public Health

"Investigating Mood Disorders and Brain Synchronization in Epilepsy: A Comparative Analysis of Dance and Mindful Meditation in Epilepsy, ADHD, and Autism”

Mood disorders such as depression, anxiety, bipolar disorder, and others are highly associated with epileptic people. This study aims to explore the relationship between mood disorders and brain synchronization in individuals with epilepsy. Brain synchronization, or inter-brain synchronization, can best be defined by the efficient and coordinated communication between various brain regions. This study will focus on utilizing interventions such as dance and mindful meditations in an effort to see results of increased brain synchronization. Additionally, the study will compare its findings with existing research on functional connectivity in individuals with other neurological disorders – specifically ADHD and autism – conducted by Dr. Basso’s Embodied Brain Lab. This comparison is crucial as both studies examine how different brain regions synchronize and function in the framework of neurological disorders. Methods will include EEG recordings as well as assessments before and after the activities to track changes in brain synchronization. It is anticipated that the mindful approaches, dance and meditation, will increase brain synchronization, potentially leading to an improved emotional balance in individuals with epilepsy. Ultimately, the findings of this research could help identify alternative therapeutic approaches that not only improve brain function but also emotional well-being in individuals with a range of neurological disorders.

Mentor(s): Julia Basso, Neuroscience, Virginia Tech
Stephanie (Nikki) Lewis, Honor's College, Virginia Tech

Emily York
Virginia Tech/Clinical Neuroscience
Sarah Radtke
Virginia Tech/Cognitive Behavioral Neuroscience

Creating an Anatomical Output Map of the Mediodorsal Thalamus: An Essential Nucleus for Attention and Decision-Making

The mediodorsal thalamus (MD) is a midline thalamic nucleus traditionally characterized strictly by a medial-lateral organization, which conveys limbic and sensory information to the prefrontal cortex (PFC) and is implicated in cognitive diseases like schizophrenia. The MD has robust excitatory and reciprocal connections with the PFC, creating a feedback loop and supporting the fine-tuning of cognitive processes like attention and decision-making. Recent anatomical tracings suggest an additional anterior-posterior gradient in MD-OFC projections, suggesting medial-lateral mapping doesn't fully capture the complexity of MD efferents. Additionally, our lab has in vivo calcium dynamic data supporting functional differences in MD relay to PFC subregions in response to a predictive cue, suggesting the MD differentially engages these subregions to support cue detection in a context-dependent manner. To investigate if these differences result from differences in MD output anatomy, the retrograde tracer cholera toxin b subunit (CTb) was injected into 3 distinct PFC areas of C57BL/6 mice: prelimbic (PrL), dorsal anterior cingulate (dACC), and orbitofrontal (OFC). Confocal microscopy and CTb expression quantification revealed distinct anterior-posterior biases: anterior MD primarily projected to PrL, posterior MD to dACC, and central MD to OFC. These findings highlight the complex organization of MD-PFC connectivity, an important nucleus supporting cognitive function.

Mentor(s): William Howe, School of Neuroscience, Virginia Tech
Kelly Runyon, School of Neuroscience, Virginia Tech
Kyra Sanders, School of Neuroscience, Virginia Tech

Hugh Young
Virginia Tech/Aerospace Engineering

Using Mathematical Models to Capture How Urban Air Mobility (UAM) Will Reshape Future Cities

The implementation of Urban Air Mobility services, and the success of said services, is dependent on the public views of UAM and the willingness of the public to use the services once they are provided. Because of this, before these services are implemented into a city, the demand for them and the manner in which they will be used must be determined in order to provide the most benefit to the communities and make the most profit. However, the demand for urban air mobility is difficult to predict as there is little to no history to base predictions on. As a result of this, most studies involved with determining the demand for Urban air mobility use surveys or focus groups to determine the public's views of UAM and their needs as a commuter. In this study, we will distribute a stated choice survey in the Houston area designed to gather data on commuters' views on urban air mobility and whether or not they would choose to use it instead of other options given different travel times, traffic conditions, and weather conditions. This data will be used to create a mathematical model to predict the demand for UAM. This model will help to provide various evidence-based policy recommendations for future smart and sustainable cities.

Mentor(s): Sami Hasnine, Civil and Environmental Engineering, Virginia Tech

Cora Youngs
Virginia Tech/Biochemistry

Histotripsy Ablation of Pancreatic Tumors Modifies Tumor Microenvironment and Improves Systemic Anti-Tumor Immunity

Histotripsy is a novel treatment modality utilizing focused ultrasound and acoustic cavitation to ablate tumor cells and generate acellular homogenates. The non-ionizing, non-thermal, non-invasive, and real time imaging properties make it a promising treatment for historically resistant malignancies such as pancreatic cancer. Our hypothesis is that the generation of acellular homogenates will activate the immune system and improve systemic anti-tumor immunity, causing the recognition of metastasized sites and produce abscopal like effects. This study was conducted using C57BL/6 mice with contralateral Pan02 tumors developed in their flanks. One tumor on each mouse was treated with histotripsy and tumor diameter and immune cell populations were measured for both tumors at 0-, 1-, 7-, 14-, and 21-days post treatment. Our data suggests that histotripsy generates an acute abscopal like effect in the treatment of pancreatic tumors through the reduction in tumor diameter and change in tumor microenvironments in both the treated and untreated contralateral pancreatic tumors. Moving forward, we aim to evaluate the mechanisms of immune cell activation including the potential presentation of neoantigens with the hope that these could be modified to create stronger abscopal like effects and offer a greater chance at remission.

Mentor(s): Irving Allen, Department of Biomedical Sciences & Pathobiology, Virginia Tech
Eli Vlaisavljevich, Biomedical Engineering and Mechanics, Virginia Tech

Ian Yu
Virginia Tech/General Studies

A NOVEL APPROACH TO MARTIAN OBSTACLE DETECTION THROUGH ULTRASONIC TRANSDUCERS

Obstacle detection in a Martian environment is currently approached using cameras. Regional and global-scale dust storms occur every year on Mars, that greatly impact the rovers on the surface. The dust from these storms reduces the visibility making cameras difficult to use. This study aims to propose a novel solution through the use of ultrasonic transducers for a sonar-based approach. A key focus was to examine the performance of such systems under atmospheric conditions similar to those on the surface of Mars. Six commercially available piezoelectric ultrasonic transducers with a peak voltage between 3.3 and 5V and a frequency of 40KHz were tested in a simulated Martian environment with temperatures between 296.15K to 253.15K and pressures from 5,000 to 9,000 mTorr. The transducers included three bimorphs, one monostatic, 1 one bimorph hydrophone, and 1 monostatic hydrophone. A microprocessor controlled communication and displayed the results which were complied and filtered using a Kalman algorithm to reduce noise and outliers. Results compiled from the transducers suggest under Martian atmospheric conditions, an error of 2.5% at worst and 7.6% at best can be observed. This indicates that with the usage of piezoelectric transducers, it is possible to detect obstacles in a Martian environment and judge their distance. While this research has the potential to be expanded under more accurate conditions by including variables such as dust or using more specialized transducers, the applicability of ultrasonic transducers in the Martian environment remains positive.

Mentor(s): Katharine Davis, Blacksburg High School

Xi Zeng
Virginia Tech/Psychology

Relations Between Prosocial Behavior and Substance Use Among College Students

Substance use is an important public concern because of its negative effect (Bell et al., 2024). Prosocial behaviors are actions intended to benefit others, such as helping and sharing (Eisenberg et al., 2015) and may play protective roles in keeping young adults from using substances (Mason et al., 2019). Public prosocial behaviors occur in front of others to gain approval and respect, while altruistic prosocial behavior is exhibited without any expectation of reward, recognition, or reciprocity (Carlo, 2014). The present study examines relations between public and altruistic prosocial behavior and college students' substance use. Participants were 808 college students (Mage = 19.1, SD = 1.21, 65% female, 79% White). Public and altruistic prosocial behaviors were measured via the Prosocial Tendencies Measure (Carlo et al., 2003). Frequency of smoking tobacco, using marijuana, and drinking alcohol were measured on a 6-point scale (1 = Not at all, 6 = Everyday). Regression analyses showed that male college students performed more public and less altruistic prosocial behavior than female college students. Only higher public prosocial behaviors were related to higher frequency of drinking alcohol, this might be due to college students' tendency to drink alcohol at social gatherings (Beck et al., 2008). This situational context may create opportunities for engaging public prosocial behaviors when others are present, potentially as a way of upholding one's reputation. These findings contribute to our understanding of the relation between substance use and prosocial behaviors in college students and have important implications for college campuses.

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