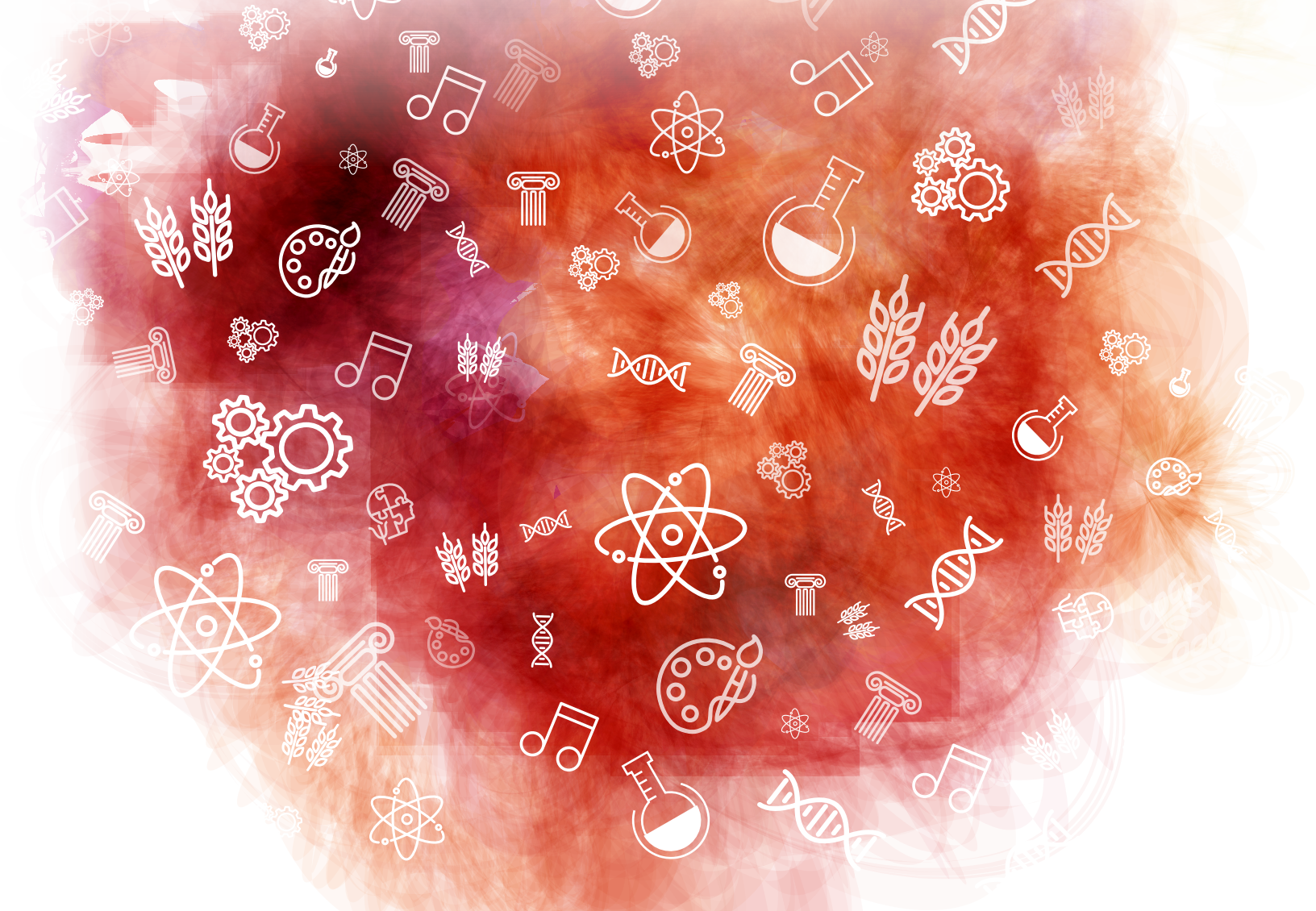

VIRGINIA TECH'S OFFICE of

UNDERGRADUATE

RESEARCH

SUMMER

SYMPOSIUM

Goodwin Hall | August 1, 2019 | 9 - 4pm

ABSTRACTS

www.research.undergraduate.vt.edu

Schedule at-a-glance

9:00-9:30am	**Check-in** Goodwin Hall Atrium
9:30-10:15am	**Welcome + Keynote Address** Goodwin Hall Auditorium
	Welcome KERI SWABY University Undergraduate Research Coordinator
	Introduction RYAN NASSER Virginia Tech Junior: English and Neuroscience
	Keynote DR. DEBORAH GOOD Associate Professor, Department of Human Nutrition, Foods, and Exercise Graduate Program Faculty
10:15-10:20am	**Break + Poster Session 1 set-up** Goodwin Hall Atrium
10:20am-11:20pm	**Poster Session 1** Goodwin Hall Atrium
11:20am-11:30pm	**Break + Poster Session 2 set-up** Goodwin Hall Atrium
11:30-12:30am	**Poster Session 2** Goodwin Hall Atrium
12:30-1:30pm	**Lunch** Goodwin Hall Atrium
	Graduate School networking
	Poster Session 2 take-down
	Poster Session 3 set-up
1:30-2:30pm	**Poster Session 3** Goodwin Hall Atrium
2:30-2:40pm	**Break + Poster Session 4 set-up** Goodwin Hall Atrium
2:40-3:40pm	**Poster Session 4** Goodwin Hall Atrium
3:40-4:00pm	**End of Symposium + Poster Session 4 take-down**

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

Welcome

As part of Virginia Tech's Beyond Boundaries long-range visioning exercise, the concept of the VT-shaped education emerged. The VT-shaped student experience provides T-shaped learning: deep knowledge and skills in at least one field of study plus broader capacities including teamwork, problem solving, communication, and critical thinking to work across disciplines and in novel or complex situations. Beyond T-shaped learning, Virginia Tech seeks to engage the whole person through curricular and co-curricular learning experiences that are purpose-driven as a manifestation of our motto Ut Prosim, "That I may serve." The "V" in the VT-shaped experience is where students learn through participation in authentic work under the guidance of a mentor. I can think of no better experience than undergraduate research.

The Summer Undergraduate Research Conference is a high point of our summer at Virginia Tech. Most students presenting today have spent ten or more weeks immersed in a research project full-time. Summer affords undergraduates the opportunities to dedicate significant time and effort to the planning, execution and analysis of a research project. They have also had the chance to become authentic members of research teams by working side-by-side with faculty, graduate students, postdoctoral fellows and research staff.

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

A very special thank you to Keri Swaby,, Nicole Easton, and our peer mentors for their tremendous work in making this symposium happen!

Enjoy!

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

Office of Undergraduate Research

Keri Swaby
University Director of Undergraduate Research

Welcome to the annual Summer Research Conference at Virginia Tech! We are extremely excited to welcome 170 presenters from 18 organized research programs and many independent labs, who will give 157 poster presentations! Over the course of the past 10 weeks, undergraduate students from Virginia Tech and across the country, as well as Virginia public school teachers and high school students, have been engaged in a wide variety of projects tackling real world problems in many disciplines. I am extremely humbled by the quality of work on show today and welcome you to enjoy and marvel at the wealth of research that took place across VT this summer.

It has been a busy summer for the Office of Undergraduate Research (OUR). We have offered common programming to more than 170 researchers which included weekly professional development seminars on topics including handling data ethically, writing personal statements, abstracts and proposals, graduate school, and presenting research. Guest speakers came from University Libraries, the Honors College, the Graduate School, and faculty and graduate students from a variety of internal and external programs. We are extremely grateful for their time and for sharing their expertise.

This summer was not only about research and professional growth. Researchers were invited to weekly Friday field trips to visit VT labs and facilities including the TREC lab, DREAMS lab, Biocomplexity Institute Labs, Library Studios, the Drone Park, ICAT, Pilot Food Processing Plant, and the Kroehling Advanced Materials Foundry. A special thank you to these facilities for opening their doors and sharing the excitement of their research. In addition, our energetic peer mentors - Cameron, Madison, Ryan, and Samantha - coordinated many social events including yoga, Cascades hike, Tubing on the New River, volunteering at the local animal shelter, and several cookouts and dinners out. Without our dedicated mentors, this summer would not have been a success. Thank you all for your incredibly hard work. And I want to extend an extra special thank you to Nicole Easton who has be instrumental in organizing OUR summer activities and today's event!

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

I hope you all enjoy the symposium. Researchers, I hope you have been inspired to continue exploring and growing. Good luck!

Sincerely,

Keri Swaby
Director of Undergraduate Research

Keynote Address

ASSOCIATE PROFESSOR and GRADUATE PROGRAM FACULTY

DR.DEBORAH GOOD

Dr. Deborah Good obtained her Ph.D. in Molecular and Cellular Biology from Northwestern University, where she characterized and patented a tumor-suppressor controlled inhibitor of angiogenesis. During her postdoctoral fellowship at the National Institutes of Health, she developed three different knockout mouse models and characterized the role of two basic helix-loop-helix transcription factors in the developing nervous system. After accepting a tenure-track position in the Department of Veterinary and Animal Sciences at the University of Massachusetts-Amherst, she developed a strong research program on hypothalamic transcriptional regulation and obesity, and was then recruited to the Department of Human Nutrition Foods and Exercise at Virginia Tech to join a growing number of transdisciplinary obesity researchers. She also spent a semester as a visiting scientist at the Max Planck Institute for Heart and Lung Research in Bad Nauheim, Germany. To date, she has secured over 3.2 million dollars in external awards and published over 55 journal articles and book chapters on the genetics of body weight regulation. She has authored two textbooks for Kendall-Hunt Publishers and has multiple papers and presentations on teaching pedagogy. She is currently a coPI on an HHMI grant to promote inclusive excellence at Virginia Tech, and serves as the Associate Department Head for Diversity Initiatives in her home department. Her passion for promoting research for undergraduates and minority students is evidenced by her development of the “Scholars program” 12 years ago. This program was originally funded by a USDA Higher Education Challenge grant, and most recently as an R25 from NIH with Dr. Samantha Harden. Overall, the Translational Obesity Undergraduate Research “TOUR” Scholars in its various iterations has sponsored over 90 students for summer undergraduate research at Virginia Tech.

2019 ACC Creativity + Innovation Scholars

The ACC Creativity and Innovation program is funded by the Inter-Institutional Academic Collaborative of the Atlantic Coast Conference (ACCIAC). It supports current Virginia Tech undergraduate students who are involved in independent research projects or creative works under the mentorship of faculty. Selected Virginia Tech scholars receive a monetary award that can be used as a stipend and/or direct support of expenses such as travel, and use of specialized research services. Students from all academic disciplines are encouraged to apply to the program to complete their student-led research project over the summer. This year's recipients and their projects are listed below.

Sid Madhavan *(Clinical Neuroscience)*
CONTRIBUTIONA OF CLINICAL TAU MUTANTS ALZHEIMER'S DISEASE AND OTHER DEMENTIAS
Faculty mentor: Bin Xu, Biochemistry

Amber Reaney *(Microbiology)*
THE EFFICACY OF OYSTER MUSHROOM (PLEUROTUS OSTREATUS) HYDROPHONICS IN REDUCING FECAL COLIFORMS IN STAGNANT SYNTHETIC WASTEWATER
Faculty mentor: Monica Ponder, Food Science and Technology

SUMMER RESEARCH PROGRAMS AT VT

PROGRAM DIRECTORS

COMPUTATIONALLY DRIVE EXPERIMENTAL BIOLOGY PROGRAM

Dr. Kristy Collins (Biocomplexity Institute)

During this 10-week summer program, Dr. Murali introduced undergraduate students to network biology algorithms. Students applied the techniques developed in this project to reconstruct yeast and human signaling pathways and how to post these networks to GraphSpace. Dr. John Tyson taught the fundamentals of mathematical modeling. Students built upon the yeast models developed in this group, simulated various models and make testable predictions.

FRALIN SUMMER UNDERGRADUATE RESEARCH FELLOWSHIP (SURF)

Keri Swaby (Office of Undergraduate Research)

The Fralin SURF program is a 10-week training program designed to give motivated Virginia Tech undergraduates the opportunity to engage in full time research in the life sciences and related professional development activities that mirror graduate training. The goal is to offer students experiences that will help them determine if they want to pursue a career in research while they develop skills for graduate school. For the past seven years, 15 to 30 exceptional students from a variety of majors are selected to participate in this competitive program. This program is funded by the Fralin Life Science Institute.

IRES: US-CHINA COLLABORATION: BATS AS MODEL ORGANISMS FOR BIOINSPIRED ENGINEERING

Dr. Rolf Mueller (Mechanical Engineering)

The IRES project is a collaborative effort among faculty members from six departments at VT and the Institute for Critical Technology and Applied Science (ICTAS). The international component of the program is conducted in the Shandong University - Virginia Tech International Laboratory in China, a facility dedicated to the engineering analysis of bat biosonar, flight, and related topics that has been in operation since 2010 and has made many pioneering discoveries on bat biosonar. Students in the IRES program work on interdisciplinary research projects that analyze the engineering principles that underlie bats' sophisticated sensing, locomotion, and navigation: How to the bats coordinate their sonar pulses with flight? What wing movements help them snatch prey in midair or drink while in flight? How do tiny adjustments of intricately sculpted ears and noseleaves modulate sonar emission and reception? And how do all these systems work together to make the bats the master of their natural habitats?

PROGRAM DIRECTORS CONTINUED...

KAUST ICTAS REU

Dr. Vinod Lohani (Engineering Education + ICTAS)

This 6-week undergraduate research program began in 2018 and eight students, sponsored by the King Abdullah University of Science and Technology (KAUST) in Saudi Arabia, participated in this program. Six VT faculty and their graduate students mentored the students. In summer 2019, 11 students are participating in this program and the mentorship list has grown to 10 faculty and their graduate students. The students study at various universities in the United States and are from Saudi Arabia. The activities are coordinated by the faculty and students in the Learning Enhanced Watershed Assessment System (LEWAS) lab. The ICTAS and VTLCI provide logistical support to the program. The program will continue in the future.

MULTICULTURAL ACADEMIC OPPORTUNITIES PROGRAM (MAOP)

Monica Hunter (MAOP Director)

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

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

PROGRAM DIRECTORS CONTINUED...

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

Dr. Vinod Lohani (Engineering Education + ICTAS)
Dr. Randy Dymond, Civil & Environmental Engineering
This NSF-RET site on WaterECubeG is a collaborative effort among faculty members in the Colleges of Engineering, Science, Natural Resources and Environment, and Agriculture and Life Sciences. Nineteen teachers (high school and community college) were trained in water research activities during the 6-week programs in summer 2017 and 2018. Eleven teachers are participating in this program in summer 2019. This includes 5 Master Teachers (MTs). The MT program is piloted in summer 2019 to develop an effective strategy to disseminate the work of the Site participants to their peers within and outside SW Virginia. The Site participants work on various interdisciplinary water research projects under the mentorship of VT faculty and graduate students. They also participated in a professional development program including field trips and learning module development activities.
The RET scholars are expected to infuse their research experiences into their courses during the academic year. One key objective of the site is to establish a community of teachers mentored in interdisciplinary water research for support, collaboration, and dissemination of site activities to a larger group of teachers in Virginia. A faculty from Virginia Western Community College is taking lead in the community development work. The Institute for Critical Technology and Applied Science (ICTAS) hosts this site. The site activities are coordinated by the faculty and students in the Learning Enhanced Watershed Assessment System (LEWAS) lab.

NSF/REU SITE: INTERDISCIPLINARY WATER SCIENCE + ENGINEERING

Dr. Vinod Lohani (Engineering Education + ICTAS)
This NSF-REU site on Interdisciplinary Water Science & Engineering at Virginia Tech was established in 2007. Three cycles (2007-09), (2011-13), and (2014-17) of this site have been completed and the 4th cycle (2017-20) is in progress . At the end of summer 2019 program, 115 REU scholars (78 women + 37 men) representing 60+ different institutions in the United States have completed the program. Faculty members and their graduate students from a number of departments including Engineering Education, Civil & Environmental Engineering, Geosciences, Biological Sciences, Forest Resources & Environmental Conservation, and School of Plant and Environmental Sciences mentor REU scholars to conduct research on various interdisciplinary aspects of water science and engineering.
The REU scholars get opportunities to conduct independent research and improve their communication (written and verbal) skills. Field trips and weekly seminars are organized to develop professional skills. Weekly social interactions are facilitated to enhance personal and professional bonding among REU scholars. The Institute for Critical Technology and Applied Science (ICTAS) hosts this site and the day-to-day activities are coordinated by the faculty and students in the Learning Enhanced Watershed Assessment System (LEWAS) lab. .

PROGRAM DIRECTORS CONTINUED...

PHYSICS NEUTRINO REU

Dr. Camillo Mariani (Department of Physics)
Betty Wilkins (Department of Physics)
Our physics faculty is engaged in a broad spectrum of research within neutrino physics, including electron/neutrino scattering experiments, the search for sterile neutrinos, phenomenology studies, long baseline optimization for DUNE and the study of neutrino spectrum from nuclear reactors and supernovae neutrino experiments and theory.
In this rich intellectual environment, the REU students will have the opportunity to pursue independent and productive activities, guided by an established team of faculty members together with assistant professors and postdocs.

TRANSLATIONAL OBESITY UNDERGRADUATE RESEARCH SCHOLARS (TOUR)

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

USDA REEU: TRAINING FUTURE LEADERS TO SOLVE PROBLEMS AT THE CONFLUENCE OF WATER AND SOCIETY

Dr. Cully Hession (BSE)
Dr. Leigh-Anne Krometis (BSE)
Dr. Brian Badgley (SPES)
This Confluence-REEU catalyzes interactions between students from widely varying disciplines by focusing on research questions that require innovative approaches to scientific collaboration and data visualization, as well as communication to and engagement with an array of local stakeholders. This 9-week program aims to guide students in developing a nuanced understanding of the environmental and social complexity of different anthropogenic stresses on water resources; demonstrate the disciplinary diversity required to address water quality problems; provide opportunities for students to improve their scientific communication skills; and establish a lifelong professional network of professionals committed to work related to interactions between water quality and human communities.
In 2019, nine fellows were selected from nine colleges and universities across the country, with disciplinary foci ranging from Civil Engineering to Political Science. Fellows worked in interdisciplinary teams of 2-3 students mentored by three or more faculty to address research topics related to the ecological and societal challenges in three local watersheds draining to the New River: Stroubles Creek in Blacksburg, Peak Creek in Pulaski, and Sinking Creek in Giles County. In addition to their primary research topic, students participated in a wide range of field trips to engage with stakeholders and learn more about how extension works to link university research directly with community needs.

PROGRAM DIRECTORS CONTINUED...

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

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

Virginia Tech's Research and Extension Experiential Learning (VT-REEL) program on Securing Our Food is a research-intensive 10-week summer experience, which engages undergraduate students in translational plant science research via a combination of hands- on laboratory and field-based experiences. VT-REEL fellows spend the first half of the program on-campus, working in molecular plant sciences labs, and spend the second half of the program at Agricultural Research and Extension Centers (AREC), working in applied plant science labs.
Eight undergraduate students from diverse academic institutions across the United States were chosen to participate in the 2019 summer program. Each VT-REEL fellow conducted a translational plant science project under the guidance of two faculty mentors: one on-campus mentor and one AREC-affiliated mentor. Students participating in the program were provided with research stipends, housing and an on-campus meal plan. Funding was obtained through the USDA-NIFA. This program will continue through 2020.

VTCRI MOLECULAR VISUALIZATION SURF

Dr. James Smyth (VTCRI + VT Biological Sciences)
Alexandria Pilot (Fralin Biomedical Research Institute)

The FBRI Molecular Visualization SURF program is a 10-week long multidisciplinary summer program at Fralin Biomedical Research Institute at VTC in Roanoke, Virginia. Seven undergraduate students participate in hypothesis-driven, independent research, each under the guidance of an FBRI faculty mentor. Students participate in a weekly workshop series to provide hands-on experience in the cutting edge imaging technologies housed within FBRI to understand appropriate application of each technology in understanding biological processes. Additionally, a weekly professional development seminar provides training in scientific ethics, communication, and career paths. The program encompasses a full-time, 40-hour work week schedule and supports Molecular Visualization SURF students with a stipend and housing. The 2019 Molecular Visualization SURF fellows came from Virginia Tech, Virginia Commonwealth University, Concord University, Hollins University, and Virginia State University.

VTCRI NEUROSURF

Dr. Michael Fox (VTCRI + VT Biological Sciences)
Alexandria Pilot (Fralin Biomedical Research Institute)

The FBRI neuroSURF program is a 10-week long program that gives VT and non-VT undergraduate students the opportunity to participate in independent translational neurobiology research at Fralin Biomedical Research Institute at VTC in Roanoke, VA. This year, program participants also included three high school students from the Roanoke Valley Governor's School and Cave Spring High School. In addition to independent research, the program includes coursework in translational neurobiology, seminars from VT and Carilion faculty whose research focuses on translational neurobiology, and professional development activities. The 2019 FBRI neuroSURF fellows came from VT, University of Virginia, University of Tennessee, Northern Virginia Community College, Amherst College, Radford University, The College of William and Mary, Roanoke College, and Lycoming College. The neuroSURF program is funded by the National Institutes of Health.

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.

GRADUATE SCHOOL

SCHOOL OF MEDICINE

TRANSLATIONAL BIOLOGY, MEDICINE, + HEALTH

MOLECULAR AND CELLULAR BIOLOGY PROGRAM

Contents

Poster Presentations
Session 1

10:20AM - 11:20AM

1 **Erik Akbar** (Virginia Tech, Nanoscience)
The Effects of Microglial Depletion on HPA-Axis Activity in a Larval Zebrafish Model
NEUROSURF

2 **Kylea Andreano** (Virginia Tech, Human Nutrition, Foods and Exercise)
Liver sinusoidal endothelial cells in non-alcoholic steatopatitis
NIDDK TRANSLATIONAL OBESITY UNDERGRADUATE RESEARCH SUMMER SCHOLARS

3 **Anissa Ashraf** (Virginia Tech, Human Nutrition, Foods, and Exercise)
Medication Adherence, Health Behaviors, and Delay Discounting in Hormone Receptor-Positive Breast Cancer Survivors
NIDDK TRANSLATIONAL OBESITY UNDERGRADUATE RESEARCH SUMMER SCHOLARS

4 **Maame-Owusua Boateng** (Northern Virginia Community College, Neuroscience)
Connexin43 Increases its Hemichannel Activity after Traumatic Brain Injury
NEUROSURF

5 **Samantha Bond** (Virginia Tech, Biological Systems Engineering)
DR-ESC-Derived Endothelial Cells and Pericytes Interaction with Types III and IV
MOLECULAR VISUALIZATION SURF

6 **Maggie Boyer** (Virginia Tech, Biological Systems Engineering)
Uterine Fibroid Ablation Using Histotripsy: A Proof of Concept Study

7 **Canace Chung** (Amherst College, Music)
Analysis of Microglia Morphology and Distribution in Visual Cortex of Control Rats and Rats with Mild Traumatic Brain Injury
NEUROSURF

8 **Christina Compton** (Virginia Tech,Human, Nutrition, Foods, and Exercise)
Antidiabetic Effects of Elenolic Acid in Vitro and in Vivo
NIDDK TRANSLATIONAL OBESITY UNDERGRADUATE RESEARCH SUMMER SCHOLARS

9 **Logan Dunkenberger** (Stanford University,)
Novel Use of Resveratrol for the Therapeutic Induction of Epstein-Barr Virus Lytic Infection
NEUROSURF

10 **Matthew Everett** (University of Tennessee, Knoxville, Biochemistry)
Elucidating CASK-Tubulin Interaction in Transfected HEK293 Cells
NEUROSURF

Poster Presentations Session 1 (continued)

10:20AM - 11:20AM

11 **Cole Faulkner** (Radford University, Biology)
Quantifying effects of mild traumatic brain injury on the morphology and distribution of microglia in visual cortex
NEUROSURF

12 **Samantha Franks** (Concord University, Pre-Professional Biology)
Analysis of Connexin43 intracellular localization during cancer plasticity
PROGRAM MOLECULAR VISUALIZATION SURF

13 **Prateek Govindaraj** (The College of William and Mary, Neuroscience)
Loss of CASK from Calretinin expressing cells leads to ataxia and cerebellar phenotypes
NEUROSURF

14 **Alana Hull** (Virginia Tech, Clinical Neuroscience)
Modulation of the default mode network using real-time fMRI
MOLECULAR VISUALIZATION SURF

15 **Kavya Iyer** (Roanoke College,Biochemistry)
Regulation of Amino Acid Transport by p53 in Glioblastoma Multiforme
NEUROSURF

16 **Alexander Jean-Francois** (Wesley College, Biology)
Exploring Fitness Awareness Mobile Applications with Former Athletes
NIDDK TRANSLATIONAL OBESITY UNDERGRADUATE RESEARCH SUMMER SCHOLARS

17 **Jenny Johnson** (Hollins University, Biology)
Structural changes to intercellular junctions during adenoviral infection influence viral spread.
MOLECULAR VISUALIZATION SURF

18 **Erin Le** (Virginia Tech, Human Nutrition Foods and Exercise)
Understanding the Role of Single Nucleotide Variants on NHLH2 in mRNA levels
NIDDK TRANSLATIONAL OBESITY UNDERGRADUATE RESEARCH SUMMER SCHOLARS

19 **Claire Lee** (Virginia Commonwealth University Chemistry/Biology)
Evaluating mechanisms underlying lymphocyte mimicry in metastatic breast cancer
MOLECULAR VISUALIZATION SURF

20 **Owen Leitzel** (Virginia Tech, Computational and Systems Neuroscience)
Impaired Blood Brain Barrier and Loss of Glutamate Transport in Atypical Astrocytes are Associated With Post-Traumatic Epileptogenesis
NEUROSURF

Poster Presentations
Session 1 (continued)

10:20AM - 11:20AM

21 **Sid Madhavan** (Virginia Tech, Clinical Neuroscience)
Identification of Key Sequences in Human Tau Protein for Aggregation in Alzheimer Disease and Related Tauopathies
ACC CREATIVITY & INNOVATION

22 **Anvitha Metpally** (Virginia Tech, Clinical Neuroscience)
Examining the psychological mechanisms underlying obesity: the importance of eating and exercise motivations and attitudes
NIDDK TRANSLATIONAL OBESITY UNDERGRADUATE RESEARCH SUMMER SCHOLARS

23 **Marc Morales** (Lycoming College, Neuroscience)
Inhibition of PI3K/P110Î_ overcomes Temozolomide resistance in Glioblastoma
NEUROSURF

24 **Christina Mounzer** (Virginia Tech, Human Nutrition, Foods, and Exercise)
Using Organoids to Investigate the Role of NIK in Colorectal Cancer
NIDDK TRANSLATIONAL OBESITY UNDERGRADUATE RESEARCH SUMMER SCHOLARS

25 **Shahd Nuri** (Virginia Tech, HNFE)
Exercise and its Effects on Blood Flow in mdx mice
NIDDK TRANSLATIONAL OBESITY UNDERGRADUATE RESEARCH SUMMER SCHOLARS

26 **Carrie Orey** (Virginia Tech, Biological Sciences)
Using Hypoxia to Induce Neuronal Phenotypes in the N29/2 Cell Line
NIDDK TRANSLATIONAL OBESITY UNDERGRADUATE RESEARCH SUMMER SCHOLARS

27 **Kyle Rega** (Virginia Tech, Biochemistry)
Argonaute 2 Knockdown Adversely Affects the Neuromuscular Junction
NEURO SURF

28 **Sam Rodgers** (Virginia Tech, Biological Systems Engineering)
Edward Jacobs
Lauren Harrison
Austin Allison
Tom Kasputis
Asthma Spacers for Low to Middle Income Countries

29 **Carlos Rodriguez** (University of Virginia)
Expansion microscopy to visualize complex retinogeniculate synapses
NEUROSURF

30 **Andrea Sanders** (Amherst College, Neuroscience)
Microcephaly-associated mutations within CASK's PDZ domain affect the CASK-syndecan-2 interaction
NEUROSURF

Poster Presentations
Session 1 (continued)

10:20AM - 11:20AM

31 **Niesha Savory** (Virginia Tech, Neuroscience)
Mitochondrial quantity differences across hippocampal subregions
NEUROSURF

32 **Noah Schrayer** (Virginia Tech, Biochemistry)
Investigating the Function of GJA1-26k and the Contribution of Internal Translation to a Genetic Disorder.
MOLECULAR VISUALIZATION SURF

33 **Benjamin Shenal** (Virginia Tech, Psychology)
Risk and Ambiguity Attitudes: Computational Modeling through Online Gamble Games.
NEUROSURF

34 **Kevin Sheng** (Roanoke Valley Governor's School)
Investigating the Effects of the Connexin43 Mimetic Peptide JM2 on Cell Migration and Microtubule Dynamics in Glioblastoma
neuroSURF

35 **Olivia Smith** (Montana State University, Nutrition Science)
Yoga Interventions for Older Adults: A Systematic Review on Issues of Internal and External Validity through the RE-AIM Framework.
NIDDK TRANSLATIONAL OBESITY UNDERGRADUATE RESEARCH SUMMER SCHOLARS

36 **Senah Stephens** (Virginia Tech, Biochemistry)
Validating a mouse line for cell specific RNA tagging
NEUROSURF

37 **Raissa Tchetcho Kemajou** (Virginia State University, Biology)
Combined effects of ephaptic and gap junctional coupling during ischemia related arrhythmogenesis attenuates conduction velocity slowing
MOLECULAR VISUALIZATION SURF

38 **Gianni Villegas** (SUNY Oswego, Biology)
Elucidating NLRX1 as an Alternative Tumor Therapeutic
NIDDK TRANSLATIONAL OBESITY UNDERGRADUATE RESEARCH SUMMER SCHOLARS

39 **Jessica Wei** (Virginia Tech Carilion Research Institute)
A Diverse Cytoarchitecture Forms Hidden Laminae in the Ventral Lateral Geniculate Nucleus
NEUROSURF

40 **Lynsey Wyatt** (Roanoke College, Psychology)
Differences in word production during intensive movement therapy
NEUROSURF

Poster Presentations
Session 1 (continued)

10:20AM - 11:20AM

41 **Andrew Miller** (Virginia Tech, Systems Biology)
Sphingosine Kinase Inhabitor Discovery Through De Novo Chemical

Poster Presentations Session 2

11:30AM - 12:30PM

1 **Michael Ackermann** (Virginia Tech, Mathematics)
Robyn Greissinger (Virginia Tech, Systems Biology)
Labiba Labanya (Virginia Tech, Computer Science)
Emily Parsons (Virginia Tech, Biological Systems Engineering)
Analysis of a Boolean Model of the Yeast Cell-Cycle Control Network
COMPUTATIONALLY DRIVEN EXPERIMENTAL BIOLOGY PROGRAM

2 **Michael Arnold** (Kent State University, Biotechnology)
Examining Herbicide Resistance & Use in the Poaceae Family
VT-REEL: SECURING OUR FOOD

3 **Katherine Berg** (Virginia Tech, Biological Sciences)
Why accurate localization and expression of Amino Acid Permease1 in Arabidopsis plants is essential to assess its role in amino acid homeostasis?
FRALIN SURF

4 **Grishma Bhattarai** (Hollins University, Economics, Mathematics)
Giving Power Back: Gender Smart Assistance to address Food Insecurity in Ethiopia
FRALIN SURF

5 **Udipta Bohara** (Hollins University , Biology)
Viability of Eastern and Western North American Mycoplasma gallisepticum Strains on Birds Feeders
FRALIN SURF

6 **Katie Capps** (Virginia Tech, Microbiology)
The role of GumN in infection by phage 7-7-1

7 **Mallory Cerkleski** (Guilford College, Sustainable Food Systems)
Soybean Yield and Quality: Mapping Genes Controlling Protein and Ensuring Ample Soil Sulfur Fertility
VT-REEL: SECURING OUR FOOD

8 **Leor Clark** (Virginia Tech, Biology)
Evidence for Connections Between Flavonoid Metabolism and the Circadian Clock in Arabidopsis Thaliana
FRALIN SURF

9 **Erin Collins** (Virginia Tech, Biochemistry)
In Silico Investigation of Multiligand Cobinding Activation in PPARÎ_ and its Natural Mutations
FRALIN SURF

10 **Tanner DeHart** (Virginia Tech, Biochemistry)
Characterization of an Essential Peptidoglycan Synthesis Enzyme in Borrelia burgdorferi, the Causative Agent of Lyme Disease
FRALIN SURF

Poster Presentations
Session 2 (continued)

11:30AM - 12:30PM

11 **Ethan Dorman** (The Pennsylvania State University, Plant Science)
Studying a Weed Pest, Observing Insect Pollinators and Pests, and Measuring a Fruit Quality Parameter in Agroscience Environments
VT-REEL: SECURING OUR FOOD

12 **Eldridge Hager** (Virginia Tech, Microbiology)
Assessment of disinfection approaches for inactivation of antibiotic resistant strains of Enterococcus faecium and Pseudomonas aeruginosa in water intended for potable reuse

13 **Cameron Hart** (Virginia Tech, Biochemistry)
Temperature and sugar feeding effects on Aedes aegypti mosquitoes' activity

14 **Madigan Hawkins** (University of Idaho, Plant Sciences: Biotechnology and Plant Genomics)
A Tale of Two Cash Crops: Stewart's Wilt in Corn and Tobacco Mosaic Virus in Flue-Cured Tobacco
VT-REEL: SECURING OUR FOOD

15 **Logan Heflin** (University of Idaho, Biotechnology and Genomics)
Exploring the importance of rain as a source of plant associated bacteria
VT-REEL: SECURING OUR FOOD

16 **Jordan Heiman** (Virginia Tech, Clinical Neuroscience)
Identification of a novel appetite stimulant, transforming growth factor beta-3 (TGFÎ_-3)
FRALIN SURF

17 **Rosa Houchins** (Virginia Highlands Community College, Science)
Conservation of native bee habitats: integrating wildflowers into pastures 2. Tracking the Tobacco mosaic virus infection from infected tobacco seeds to seedlings by Quantitative Real-time PCR Analysis
VT-REEL: SECURING OUR FOOD

18 **Julia Hudack** (Virginia Tech, Biological Sciences)
Towards Detoxifying Poison Ivy Hairy Roots Using CRISPR Genome Editing
FRALIN SURF

19 **Grant Kawecki** (Virginia Tech, Biochemistry)
Insight into Islet Amyloid Polypeptide (IAPP) and Amyloid-Î_ Peptide Interactions Using Molecular Dynamics Simulations

20 **Soonyoung Kim** (Virginia Tech, Psychology)
Deep Selection: Inferring Employee Traits from Resume Style Using Neural Networks
FRALIN SURF

Poster Presentations
Session 2 (continued)

11:30AM - 12:30PM

21 **Jiwoo Kim** (Virginia Tech, Biochemistry)
Analyzing Receptor Abundance in Sinorhizobium meliloti
FRALIN SURF

22 **Trent Kite** (Virginia Tech, Microbiology)
Structural and Functional Characterization of the Putative Peptidoglycan Binding Domain Protein LysMD3
FRALIN SURF

23 **Piper MacNicol** (Virginia Tech, Chemistry)
Elucidating the Effect of Polymer Molecular Weight on Metal Chelation

24 **William Martin** (Virginia Tech, Environmental Resources Management)
Influence of Predation and Habitat Complexity on the Functional Stability of Stream Insect Communities

25 **Frank Mazzola** (Virginia Tech, Civil Engineering)
Impact of High Chloride Levels in Galvanized Iron Infrastructures and Possible Corrosion Control Strategy in Washington Suburban Sanitary Commission (WSSC)

26 **Jonathon Monroe** (Virginia Tech, Biological Sciences)
Microbial Metabolic Fingerprints of Tributary Streams

27 **Austin Murray** (Virginia Tech, Biochemistry)
A Putative Amphipathic Î±-Helical Motif in Brome Mosaic Virus Potentially Sufficient for Targeting the Perinuclear Endoplasmic Reticulum
FRALIN SURF

28 **Harveen Pantleay** (Virginia Tech, Psychology)
Help-seeking attitudes moderate the relationship between stress and psychological quality of life in college students
FRALIN SURF

29 **Benjamin Rayden** (Virginia Tech, Computational Modeling and Data Analytics)
Supporting the Advancement of Virginia Based Opioid-Related Resources by Creating a User-Friendly and Consistently Aggregated Data Resource

30 **Breonna Runk** (Virginia Tech, Biology)
Investigating the Role of Iron in Plant Pathogenic Oomycetes for Novel Disease Resistance Strategies
FRALIN SURF

Poster Presentations
Session 2 (continued)

11:30AM - 12:30PM

31 **Tahja Stewart** (Norfolk State University, Biology)
The Different Ways Bacteria Can Contribute to Agriculture
VT-REEL: SECURING OUR FOOD

32 **Sophia Textoris** (Virginia Tech, Human Development & Psychology)
The Impact of Nonfatal Suicidality on Sibling Relationships: A Look At Stress, Distress, and Functioning
FRALIN SURF

33 **Taylan Tunckanat** (Virginia Tech, Biochemistry)
In vitro characterization of Lysine-2,3-aminomutase from Methanococcus maripaludis
FRALIN SURF

34 **Colleen Valentine** (Virginia Tech, Clinical Neuroscience)
Effects of eccentric skeletal muscle loading on tendon adaptation: A Preliminary Histological Analysis

35 **William Vaughn** (Virginia Tech, Chemistry)
Bioinspired polymers for sequestration of doxorubicin during chemotherapy treatment

36 **Maria Villafuerte** (Virginia Tech, Clinical Neuroscience)
Neurodevelopmental Consequences of Early Life Ethanol Exposure
FRALIN SURF

37 **Rachael Walcheck** (Iowa State University, Microbiology)
Collection of Volatile Compounds from Arachis hypogaea infected with Sclerotium rolfsii
VT-REEL: SECURING OUR FOOD

38 **Addison Webster** (Virginia Tech, Experimental Neuroscience)
Hypothalamic mechanism of neuropeptide S-induced satiety
FRALIN SURF

39 **Kevin Williams** (Virginia Tech, Biochemistry)
Global characterization of Fusobacterium virulence proteins using genomics, bioinformatics, and cellular microbiology
FRALIN SURF

40 **Rowan Wooldridge** (Virginia Tech, Biochemistry)
In vitro characterization of Sinorhizobium meliloti Methyl Accepting Chemotaxis Proteins McpW and McpZ
FRALIN SURF

Poster Presentations
Session 2 (continued)

11:30AM - 12:30PM

41

Mitch Woodhouse (Virginia Tech, Biological Systems Engineering)
Shannon Kate Barrett-Johnson (Virginia Tech, Computer Science)
Matthew Trang (Virginia Tech, Electrical Engineering)
Kailey Kinslow (Virginia Tech, Industrial Systems Engineering)
Anvitha Nachiappan (Virginia Tech, Industrial Systems Engineering)
Use of a Clicker Band in Aiding an Individual Affected by a Spinal Cord Injury

Poster Presentations Session 3

1:30PM - 2:30PM

1. **Laith Abdulmajeid** (University of Wisconsin-Madison , Mechanical Engineering)
   Constitutive modeling of compacted snow
   ICTAS-KAUST REU

2. **Ibrahim Abugharah** (Harvey Mudd College, Math and Computational Biology)
   Investigation of the Role of Spatial Organization in the Emergent Behavior of Quorum Sensing and Quorum Quenching Bacteria
   ICTAS-KAUST REU

3. **Deema Alabduljabbar** (UC Davis, Biomedical Engineering)
   Forces Exerted By Cytoplasmic Fragments Generated Autonomously Under Different Fiber Geometries
   ICTAS-KAUST REU

4. **Abdulaziz Alali** (UCSD, Chemistry)
   Improving Drug Delivery using Hydrogels
   ICTAS NSF-REU: INTERDISCIPLINARY WATER SCIENCES AND ENGINEERING

5. **Yazid Alamry** (UNC, Chemistry)
   Improving Li Batteries
   ICTAS-KAUST REU

6. **Munirah Aldarwish** (Smith College, Environmental Geoscience)
   bioelectrochemical system
   ICTAS-KAUST REU

7. **Hasan Almahfoudh** (Purdue University, Physics)
   Energy Harvesting and Vibration Control of Off-shore Platforms
   ICTAS-KAUST REU

8. **Mallory Alman** (NC State University , Biological & Agricultural Engineering)
   Comparing Inactivation of Antibiotic Resistance Genes by Chlorination and Maturation Pond Treatment in Indian Wastewater Treatment Plants
   ICTAS NSF-REU: INTERDISCIPLINARY WATER SCIENCES AND ENGINEERING

9. **Ahmed Almatar** (The Pennsylvania State University , Mechanical Engineering)
   Ocean Wave & Solar Powered Saline Water Membrane Desalination
   ICTAS-KAUST REU

10. **Layla Almualem** (Virginia Tech, Biological Systems Engineering)
    Enhanced Removal of Hazardous Azo Dye and Ammonia recovery from textile waste water by a Membrane Electrochemical Reactor
    ICTAS-KAUST REU

Poster Presentations
Session 3 (continued)

1:30PM - 2:30PM

11 **Abdullah Alyamani** (Boston University, Earth and Environmental Science)
Synthesis of Nanoparticles as Sensors for Environmental Contaminants
ICTAS-KAUST REU

12 **Trevor Amestoy** (University of New Mexico, Civil Engineering)
Quantifying peat hydraulic properties: a comparison of methods and peat layers to better understand consequences of drainage at the Great Dismal Swamp, U.S.A.
ICTAS NSF-REU: INTERDISCIPLINARY WATER SCIENCES AND ENGINEERING

13 **Colin Baciocco** (Yale University, Geology and Geophysics)
Kestrel Owens (University of Vermont, Civil Engineering)
Isabelle Largen (Virginia Tech, Water: Resources, Policy & Management)
Invisible water quality: Identifying spatiotemporal variation in water chemistry and water resource perceptions in Stroubles Creek headwaters
CONFLUENCE REEU

14 **Austin Batz** (College of William and Mary, Physics)
Data Analysis of (e,e'p) Argon and Titanium Electron Scattering
PHYSICS NEUTRINO REU

15 **Maitland Bowen** (University of Michigan, Physics)
Inverse beta decay and coherent elastic neutrino nucleus scattering -- a comparison
PHYSICS NEUTRINO REU

16 **Aidan Bradley** (Virginia Tech, Engineering)
Michael Goldsworthy (Virginia Tech, Computer Science)
Xavier Harrison (Virginia Tech, Creative Technologies)
Walter Newsome (Virginia Tech, Computer Engineering)
Georgina Dzikunu (WSSU, Biology)
Tracking of bat mobility and vocalizations near foliage
NSF US-CHINA COLLABORATION: BATS AS MODEL ORGANISMS FOR BIOINSPIRED ENGINEERING

17 **Brandon Christensen** (Virginia Tech, Aerospace Engineering)
Space Simulation Survey: Leading Developments Towards Using Multi-Rotors to Simulate Space Vehicle Dynamics

18 **Jessica Christian** (University of Maryland, Baltimore County, Physics)
Maximizing the KURF materials screening sensitivity with a cosmic ray veto
PHYSICS NEUTRINO REU

19 **Rachael Dal Porto** (California State University, Sacramento, Civil Engineering and Chemistry)
Effects of Water Quality on Aerosol Size and Number Concentration Distribution Emitted from an Ultrasonic Humidifier
ICTAS NSF-REU: INTERDISCIPLINARY WATER SCIENCES AND ENGINEERING

20 **Lance De Koninck** (Virginia Tech, Engineering Science and Mechanics)
Passive Anti-Frosting Cables via Microscopic Ice Patterns

Poster Presentations
Session 3 (continued)

1:30PM - 2:30PM

21 **Grace Dunleavy** (Drake University, Physics)
The Impacts of Cosmic Ray Interactions on Dark Matter Detection
PHYSICS NEUTRINO REU

22 **Georgina Dzikunu** (Winston-Salem State University , Biology)
Survey of bat habitats in China
NSF US-CHINA COLLABORATION: BATS AS MODEL ORGANISMS FOR BIOINSPIRED ENGINEERING

23 **Leah Ford** (University of South Carolina, Chemical Engineering)
Cultivation of Microalgae in an Osmotic Photo-Bioreactor for Wastewater Treatment and Agricultural Reuse
ICTAS NSF-REU: INTERDISCIPLINARY WATER SCIENCES AND ENGINEERING

24 **Andrew Fugaro** (Virginia Tech, Engineering Science and Mechanics)
Arrested Dynamics of Droplets Impacting Icy Surfaces

25 **Michael Goldsworthy** (Virginia Tech, Computer Science)
A Multi-Modal Data Set on Bat Habitats and Biosonar Behavior
NSF US-CHINA COLLABORATION: BATS AS MODEL ORGANISMS FOR BIOINSPIRED ENGINEERING

26 **Basim Gotah** (CU Boulder, Physics)
Biomimetic echomotion robot bats

27 **Andrew Gunsch** (Coe College, Physics)
Passive Attenuation to Allow Muon Calibration of NuLat Detector
PHYSICS NEUTRINO REU

28 **Xavier Harrison** (Virginia Tech, Art; Creative Technologies)
Laser scanning of bat habitats in Asia
NSF US-CHINA COLLABORATION: BATS AS MODEL ORGANISMS FOR BIOINSPIRED ENGINEERING

29 **Kathleen Hohweiler** (Towson University , Geology)
Bailey Snyder (Allegheny College , Global Health Studies)
Sinjin Blackwell (Virginia Tech, Chemistry)
The Doodle Dust Dilemma: Public Perception and Heavy Metal Detection at a Former Superfund Site
CONFLUENCE REEU

30 **Grant Hutchins** (Virginia Tech, Aerospace Engineering)
Ben Pritchard (Virginia Tech, Aerospace Engineering)
Bryan Wells (Virginia Tech, Aerospace Engineering)
Joseph Cunningham (Virginia Tech, Aerospace Engineering)
Pedro Henrique Do Nascimento (Virginia Tech, Computer Engineering)
Jake Lurie (Virginia Tech, Aerospace Engineering)
SPACEDRONES: An Autonomous Multi-Agent Space System Testbed (AMASST) Utilizing Quadrotors to Simulate CubeSat Proximity and Rendezvous Operations
SPACE @ VT

Poster Presentations
Session 3 (continued)

1:30PM - 2:30PM

31 **Jenna Israel** (Cornell University, Environmental Engineering)
Comparing quality of wastewater treatment plant biosolids with respect to antibiotic resistance genes in the United States and India
ICTAS NSF-REU: INTERDISCIPLINARY WATER SCIENCES AND ENGINEERING

32 **John Schafer** (Virginia Tech, Electrical Engineering)
Grant Hutchins (Virginia Tech, Aerospace Engineering)
Ben Pritchard (Virginia Tech, Aerospace Engineering)
Rob Engebretson (Virginia Tech, Aerospace Engineering)
An OLED Smartphone Scene Generator with Total Pixel Control in Support of Virginia Tech's Space Situational Awareness (SSA) Telescope Program
SPACE @ VT

33 **Lydia Loan** (State University of New York College of Environmental Science and Forestry, Environmental Resources Engineering)
Monitoring Macroinvertebrate Community Behavior Along a Flow Gradient in Sinking Creek, VA
ICTAS NSF-REU: INTERDISCIPLINARY WATER SCIENCES AND ENGINEERING

34 **Ashley Mickens** (Miami University, Environmental Earth Science)
Predicting methane emissions in a eutrophic reservoir using an iterative near-term forecasting model
ICTAS NSF-REU: INTERDISCIPLINARY WATER SCIENCES AND ENGINEERING

35 **Abigail Supplee** (Roanoke College, Environmental Studies and Political Science)
Shayla Triantafillou (University of Vermont, Environmental Sciences and Geography)
An interdisciplinary approach to visualizing the social and environmental impacts of a sinking stream system
CONFLUENCE REEU

36 **Walter Newsome** (Thomas Nelson Community College, Computer Engineering)
A biomimetic sonarhead for surveying bat habitats in Asia
NSF US-CHINA COLLABORATION: BATS AS MODEL ORGANISMS FOR BIOINSPIRED ENGINEERING

37 **Cecilia Salazar Teran** (Virginia State University , Biology)
Using Soil Stabilizers to Reduce Water Infiltration in Vineyard Soils
ICTAS NSF-REU: INTERDISCIPLINARY WATER SCIENCES AND ENGINEERING

38 **Matthew Soliman** (University of Cincinnati , Health Sciences)
Degradation of Legionella pneumophila gene markers in potable water during exposure to free chlorine, monochloramine, and chlorine dioxide
ICTAS NSF-REU: INTERDISCIPLINARY WATER SCIENCES AND ENGINEERING

39 **Jacob Steenis** (Grinnell College, Physics)
Neutron Captures in Borated Polyethylene: An Analysis of the Quenching Measurement Data from MicroCHANDLER at TUNL
PHYSICS NEUTRINO REU

40 **Grace Strid** (Oregon State University, Mathematics)
Evaluation of the Effects of Interaction and Display Fidelity in Interdisciplinary Hydrology Education by Comparing Novel Interfaces
ICTAS NSF-REU: INTERDISCIPLINARY WATER SCIENCES AND ENGINEERING

Poster Presentations
Session 3 (continued)

1:30PM - 2:30PM

41 **Stephanie Toole** (California State University, Northridge, Physics)
Using Cosmic Ray Veto to Increase Radiation Sensitivity at KURF
PHYSICS NEUTRINO REU

42 **Terrell Worrell** (Virginia Tech, Engineering Science and Mechanics)
Study of Gliding Chrysopelea body orientations and resulting aerodynamics during shallow glide stages with 3D imaging camera arrays

Poster Presentations
Session 4

2:40PM - 3:40PM

1 **Said Abou Draa** (Virginia Tech, Civil Engineering)
Understanding energy literacy concepts by using home examples
MAOP

2 **Patricia Asiatico** (Virginia Tech, Civil Engineering)
Effects of a Building's Expected Lifetime on its Environmental Impact
MAOP

3 **Amanda Barnes**
The Indirect Effects of Urban Development on Stream Biota
ICTAS NSF-RET E3G

4 **Chris Barnes**
valuating the role of draw solute selection in forward osmosis wastewater processing
ICTAS NSF-RET E3G

5 **Shawn Becker**
Dissolved oxygen levels as a factor in determining the health of freshwater ecosystems
ICTAS NSF-RET E3G

6 **Bryan Bloomfield** (Morehouse College , Physics)
Characterizing harmful algal blooms (HABs) below the water surface using unmanned systems and underwater GPS
SCHMALE LAB NSF REU

7 **Skeens Brooke** (southwest virginia community college, premed and an advance in science)
Evaluation of blood packed cell volume in cattle with and without Theileria orientalis Ikeda genotype
MAOP

8 **Jason Bruno Terceros** (Virginia Tech, Mechanical Engineering)
Evaluating water quality impacts of urban runoff in Stroubles Creek using grab and continuous measurements
MAOP

9 **Melissa Carr**
Investigation of Copper Speciation, Complexation, and Precipitation in Drinking Water Systems through Bench Scale Testing and Field Sampling
ICTAS NSF-RET E3G

10 **Chloe Coleman** (Concord University, Psychology)
Interaction Effects of Religion and Stress on Neural Cognitive Control in Adolescents
MAOP

Poster Presentations
Session 4 (continued)

2:40PM - 3:40PM

11 **Hamilton Crockett** (Virginia Tech, Agronomy)
Ice Nucleation Activity of Birch Trees in Different Seasons

12 **Christine Faunce** (Virginia Tech, Neuroscience; Chemistry)
Single Nucleotide P129T Mutation Shows Susceptibility to Problematic Drug Use in Mice
MAOP

13 **Jessica Gannon** (Virginia Tech, Mechanical Engineering)
Development of Histotripsy as a Non-Invasive Focused Ultrasound Ablation Method for the Treatment of Pancreatic Cancer
MAOP

14 **Anthony Abe Oliver Gemina** (Virginia Tech, Mechanical Engineering)
3D Reconstruction: Archiving High Quality 3D Models from 2D Images
MAOP

15 **Jared Harvey** (Virginia Tech, Computer Science Engineering)
Towards Wrist Tremor Control Through an Exoskeleton
MAOP

16 **Luis Hernandez** (Virginia Tech, Civil and Environmental Engineering)
Blast Performance of Hybrid Internal FRP- and Steel- Reinforced Concrete Construction
MAOP

17 **Cecil Hickam**
SURFACE COAL MINING IN CENTERAL APPALACHIA: IS BIOACCUMULATION OCCURRING IN THE HEADWATER STREAMS?
ICTAS NSF-RET E3G

18 **Charlie Holguin** (Beloit College , Ecology, Evolution, and behavioral Biology)
The Effects of Silvicultural Treatments and Climate on Plethodon cinereus
MAOP

19 **Alexis Jackson** (Virginia Tech, Biological Sciences)
Wetlands in a warming world: The importance of wetlands in headwater carbon cycling

20 **Kayla Jones** (North Carolina A&T State University, Animal Science)
The Result of Nerve Growth Factor Beta Improving Embryonic Cleavage Rates
MAOP

Poster Presentations
Session 4 (continued)

2:40PM - 3:40PM

21 **Mariama Kabore** (Virginia Tech, Microbiology)
LdtR, a master transcriptional gene regulator, modulates motility in Sinorhizobum meliloti
MAOP

22 **Kendall Kelley** (University of Georgia, Mechanical Engineering)
Residential HVAC System Performance Comparison Using Cloud Computing
MAOP

23 **Nathan Lam** (Virginia Tech, Computer Science)
Functionality in 3D printed low-cost upper-extremity prosthetics
MAOP

24 **Nicole Lopez-Vega** (University of Puerto Rico, Rio Piedras Campus)
Role of the PH and FYVE domains of the autophagic protein Phafin2
MAOP

25 **Aracely Mendoza** (Washington State University, Biology)
Are Traditions Salient To How U.S. Latinx Members Interact With Their Communities
MAOP

26 **Brianna Miranda** (Virginia Tech, Geosciences)
Evaluating marine records of polar environmental change during a past global warming event
MAOP

27 **Ada Morral** (Virginia Tech, Physics)
Nonlinear Processes in Artificially Designed Nano-Structures
MAOP

28 **Aaron Napier**
Land Use as a Factor in Nutrient Loading in Karst Streams
ICTAS NSF-RET E3G

29 **Nhat Quang Nguyen** (SUNY ESF, Biotechnology)
Cytocompatibility of Novel Tripeptide Hydrogel for Use in Biomedical Applications
MAOP

30 **Kaavya Nimmakayala** (Virginia Tech, Materials Science and Engineering)
De-icing through two novel chemical and mechanical techniques
MAOP

Poster Presentations
Session 4 (continued)

2:40PM - 3:40PM

31 **Karen Perez-Serpa** (Virginia Tech, Electrical Engineering)
Nathan Lam (Virginia Tech, Computer Science)
David Rwigema (Virginia Tech, Civil Engineering)
Development of Low Cost Elbow Powered Prosthetic for Child With Upper Limb Disability
MAOP

32 **Autumn Peterson** (Virginia Tech, Environmental Science)
Increased Salinity Facilitates Higher Abundances of Freshwater Microorganisms
MAOP

33 **David Rwigema Makuza** (Virginia Tech, Civil Engineering)
3D printed prosthetic-arm personalized for participant's specific birth defect
MAOP

34 **Craig Schichtel** (Virginia Tech, Electrical Engineering)
Mobile Robot for Overhead Transmission Line Inspection
MAOP

35 **Diana Schmidt**
ICTAS RET

36 **Brooke Skeens** (Southwest Virginia Community College, Pre Med and an Advance in Science)
Evaluation of blood packed cell volume in cattle with and without Theileria orientalis Ikeda genotype
MAOP

37 **Christian Sorenson** (Virginia Tech, Aerospace Engineering)
Space Weather Data Analysis: Developing software tools to aid in the search for ultra-low-frequency waves (ULFWs) by means of data visualization
MAOP, SPACE @ VT

38 **Catherine Twyman**
Shaunna Young (William Fleming High School, Earth/Environmental Science)
Rachelle Rasco (Carroll County High School, STEM Lab Manager)
Katie Holcomb (Patrick Henry High School, Biology)
Steve Ahn (Holston High School, Biology, Environmental Science)
Teachers Supporting Teachers: Piloting a Master Teacher program within an NSF/Research Experiences for Teachers (RET) Program
ICTAS NSF-RET E3G

39 **Michelle Worek** (Virginia Tech, Geosciences)
Crystal Formation onto an Organic Matrix: Effect of pH on Nucleation Rate and Polymorphs of Calcium Carbonate
MAOP

Abstracts

LAITH ABDULMAJEID
UNIVERSITY OF WISCONSIN-MADISON/MECHANICAL ENGINEERING

Constitutive modeling of compacted snow

Tire performance on snow is an important factor to take into consideration in the design process. Building and testing prototypes in real life can be expensive and inefficient. Numerical simulation can be a useful and inexpensive method to test tire design in snowy conditions. Limitations to this method include inaccurate models for compacted snow on the roads. The purpose of this study is to review previous work done in snow modeling in regard to the parameters used to characterize the snow, as well as provide a working model and validate it using data from previous literature.

Mentor(s): Costin Untaroiu (Virginia Tech, Biomedical and Mechanics)

SAID ABOU DRAA
VIRGINIA TECH /CIVIL ENGINEERING

Understanding energy literacy concepts by using home examples

Energy is being used at larger quantities than ever before but often this goes unnoticed. This is especially prevalent in the United States where we consume one of the largest quantities on energy in the world. The increase in unawareness by consumers leads to an increase of negative impacts on the environment over time. The goal of this study is to understand how resident and visitor interactions with homes affect their understanding of Energy Literacy Concepts (ELC). This goal is approached by conducting interviews which are analyzed using qualitative studies that consist of making codes to analyze the information. The literacy concepts that are explored in this study are: human use of energy is subject to limits and constraints, humans generate electricity in multiple ways, the amount of energy used can be calculated and monitored, conservation is one way to manage energy resources, and social and technological innovation affects the amount of energy used by society. Interview data shows how home examples have a positive impact on the understanding of energy literacy concepts by making it more personal and relatable for residents. Consequently, participants describe their preference of active home examples over passive traditional teaching methods. While ELC won't solve climate issues by themselves, an energy literate society will have the knowledge to make better energy consumption decisions and will be motivated to address energy and climate issues. The role of professionals in the field, educators, and policymakers is key to encourage society to be more energy literate.

Mentor(s): Frederick Paige (Virginia Tech, department of civil and environmental engineering)

IBRAHIM ABUGHARARH
HARVEY MUDD COLLEGE/MATH AND COMPUTATIONAL BIOLOGY

Investigation of the Role of Spatial Organization in the Emergent Behavior of Quorum Sensing and Quorum Quenching Bacteria

Bacteria have been the focus of much research due to their prevalence in natural systems and engineered roles alike. Quorum sensing (QS) is a mechanism that many species of bacteria use to produce coordinated responses via the production and sensing of small diffusible signaling molecules. Moreover, some bacteria have mechanisms in place to disrupt QS, known as quorum quenching (QQ). In this work, we investigate the role of spatial organization in the behavior of QS and QQ bacteria. Specifically, we studied the transient chemotaxis and QS responses in mixed populations of engineered QS Escherichia coli and QQ Salmonella Typhimurium in the well-controlled environment of a microfluidic device. Spatial control of the bacterial populations was achieved by imposing concentration gradients of nutrients and the Salmonella repellent phenol. We first characterized the bacterial population organization as a function of the nutrient gradient and the ratio of QQ to QS bacteria, finding that the extent of co-localization depends on both parameters. We then recorded QS activation times as a function of the strain concentrations. These results will be used to extend an existing computational model of QS dynamics to include interactions with QQ bacteria. This research will enhance our understanding of QS-based behavior, such as its role in the pathogenesis of infectious diseases such as cholera. Moreover, our experimentally-validated model will allow for improved decentralized control of engineered bacteria swarms, which can be used for applications ranging from biosensing to cancer treatment.

Mentor(s): Bahareh Behkam (Virginia Tech, Mechanical Engineering), Eric Leaman, Virginia Tech, Mechanical Engineering, leamanej@vt.edu

MICHAEL ACKERMANN
VIRGINIA TECH /MATHEMATICS
ROBYN GREISSINGER
VIRGINIA TECH /SYSTEMS BIOLOGY
LABIBA LABANYA
VIRGINIA TECH /COMPUTER SCIENCE
EMILY PARSONS
VIRGINIA TECH /BIOLOGICAL SYSTEMS ENGINEERING

Analysis of a Boolean Model of the Yeast Cell-Cycle Control Network

The goal of this project is to model how genes and proteins interact with each other to control progression through the cell cycle in budding yeast. In order to understand the interactions, we analyzed the dynamical properties of a Boolean model1 of the control system and compared across perturbed networks. Boolean models simplify the underlying molecular mechanisms by representing complex interactions in terms of â€œactiveâ€ù or â€œinactiveâ€ù states. Utilizing the Python package NetworkX, we were able to efficiently compute state space networks and upload these models to a graph visualization tool, GraphSpace. Additionally, we derived functions to measure certain properties of these networks including basin size, traffic, and presence of the cell cycle. We verified the results of Li et al.; however, our investigation of additional perturbations has called into question the biological relevance of the model. Further research would include trying to preserve the biological relevance by the revisions of the model and applying this modeling framework and analysis to cell-cycle control in more complex organisms.

Mentor(s): T.M. Murali (Virginia Tech, Computer Science), John J. Tyson, Virginia Tech, Systems Biology

ERIK AKBAR
VIRGINIA TECH /NANOSCIENCE

The Effects of Microglial Depletion on HPA-Axis Activity in a Larval Zebrafish Model

Microglia, the monocytic-macrophages of the central nervous system (CNS) are primarily associated with synaptic remodeling and CNS immunity. While microglia have been well characterized in many regions of the CNS, little is known about their role in hypothalamic-pituitary-adrenal cortex axis (HPA axis) activity. The HPA axis is the main circuit responsible for the release of cortisol and induction of the stress response. Previous work in the lab revealed significant activity changes in the hypothalamus and pituitary of larval microglial-depleted zebrafish through whole-brain activity mapping. Microglia were depleted in the zebrafish through a mutation of interferon-regulatory factor 8 (irf8), a critical factor for microglial entry into the CNS. In order to confirm that the previously observed alterations to HPA-associated brain regions correlates to disrupted HPA axis signaling, we performed immunolabeling and in situ hybridization for critical HPA axis components including Adrenocorticotropic hormone (acth), Corticotropin-releasing hormone (crhb), arginine vasopressin (avp). These components are the primary signaling molecules between the major regions of the HPA, and the procedures allow us to measure their expression. This research allows us to further investigate the role microglia play on a circuit wide level and may help further elucidate factors affecting stress in the CNS.

Mentor(s): Dr. Yuchin Pan (Virginia Tech, Carilion)

DEEMA ALABDULJABBAR
UC DAVIS/BIOMEDICAL ENGINEERING

Forces Exerted By Cytoplasmic Fragments Generated Autonomously Under Different Fiber Geometries

Th extracellular matrix (ECM) provides a complex environment of biophysical and biochemical cues which dictate many of the cellular functions in physiological and pathological conditions. While the importance of fibrous ECM is appreciated, limitations in current fiber manufacturing techniques renders poor control of scaffold dimensions (diameter-spacing-orientation). Using the non-electrospinning technique of Spinneret-Based Tuneable Engineered Parameters (STEP) technique, we studied the influence of fiber architecture and diameter on the generation of cellular fragments from human mesenchymal stem cells (hMSCs). Cytoplasmic fragments are independent bodies generated from cells which lack nuclear material. These fragments have been implicated as chemical beacons in various pathological conditions. Using anisotropic and crosshatch geometries, we demonstrate the formation of these fragments without any external simulation. These fragments demonstrate movement independent of the parent cell body and remain active for at least 12 hours. Interestingly, these structures exhibit oscillatory motion on anisotropic fibrous arrangement, and to a much lesser extent on fibrous crosshatch geometry. Using Nanonet Force Microscopy (NFM) and information about actin and paxillin distribution obtained from fixed staining, we are able to precisely measure the forces applied by these bodies showing the presence of contractile machinery in them. Interestingly, we do not observe a correlation of forces exerted with the size of these structures. While the cells were migrated along anisotropic fibers, they also exhibited Contact Inhibition of Locomotion (CIL) which refers to the phenomena of change in migration direction after coming in contact with other cells. Together, we show interesting cellular behaviour being triggered by fibrous arrangement and dimensions.

Mentor(s): Abinash Padhi (Virginia Tech, ICTAS, Mechanical Engineering), Dr. Amrinder S. Nain, Virginia Tech, ICTAS, Mechanical Engineering

ABDULAZIZ ALALI
UCSD/CHEMISTRY

Improving Drug Delivery using Hydrogels

The way we take drugs today are rather inefficient. By taking the drug orally, the body's intestine absorbed it quickly and then the drug is filtered quickly through the kidneys and the liver, so the one dose of the drug only remains in the body for a few hours maybe a half day at best. This study aims to maximize the efficiency of drug delivery by using a hydrogel as a carrier of the drug inside the body. The hydrogel would act as a carrier of the drug and slowly release the drug inside the body, so that one dose of the drug would last for days rather than hours. To test this hypothesis, we prepared Jeffamine (2000)-OX-HPC Hydrogel and combined it chemically with Phenylalanine. The Phenylalanine would act as the hypothetical drug because we can expect it to act similarly to most drugs because they all share a primary amine functional group that will make them behave very similarly with the hydrogel we have. The hydrogel combined with the hypothetical drug was placed in chemical conditions similar to that of the human body (PH= ~7.4) and the release of the drug was tracked using UV-visible spectroscopy. The dose of the drug was released fully in the duration of about three days.

Mentor(s): Junyi Chen (Prof. Kevin Edgar's group)

YAZID ALAMRY
UNC/CHEMISTRY

Improving Li Batteries

In order to improve Li batteries performance, the research focused on two components, the amount of lithium and the coating for the cathode materials. The goal was to achieve a higher energy density and. a better capacity retention. The batteries were made with NMC811 and calcinated with varying excess of lithium hydroxide. The material was then calculated a second time with boric acid in order to coat it with boron oxide. We found that between 3% and 5% by weight excess lithium hydroxide, the 5% had a better capacity retention. The boric acid battery are still going through testing.

Mentor(s): Feng Lin (VT, Chemistry), Zhengrui XU, VT, Chemistry

MUNIRAH ALDARWISH
SMITH COLLEGE/ENVIRONMENTAL GEOSCIENCE

Generation of bioenergy and wastewater treatment by utilizing a photo-bioelectrochemical system

In microbial fuel cells (MFCs), electro-active bacteria form a living biofilm on the anode surface and produce electrical current while decomposing organic compounds. Continuous oxygen provision is key for the successful operation of MFCs but is also an energy intensive process. An MFC integrated with an algae bioreactor were coupled to treat wastewater by way of removing organic matter through the MFC in the anodic chamber and nitrogen and phosphorous by the algae in the cathodic chamber (algae reactor). Additionally, biofuels from the algal mass and bioelectricity from the MFC were harvested as part of their natural processes. The MFC and algal bioreactor were operated in a tubular container where synthetic wastewater was continuously pumped into the anode, and the anolyte effluent was directed to the algal bioreactor. The algae were able to grow by artificial illumination, which provided oxygen to the cathode chamber of the MFC thus eliminating the need for aeration. The bioreactor produced a stable power density of 4.9 W/m3 on a daily basis over two weeks and could be a promising technology to improve the energy benefits and wastewater treatment efficiency of MFCs.

Mentor(s): Dr. Zhen He (Virginia Tech, EBBL), Zixuan Wang, Virginia Tech, EBBL

HASAN ALMAHFOUDH
PURDUE UNIVERSITY/PHYSICS

Energy Harvesting and Vibration Control of Off-shore Platforms

An issue that faces off-shore platforms and reduces their efficiency is the vibrations caused by the harsh environment and the vibrations of the machines on the platform. The research in this problem has suggested that using dampers can help significantly reduce the vibrations. One of the suggested dampers to reduce the vibrations is Tuned Mass Damper (TMD). The questions to answer here is how can we develop this damper to achieve maximum efficiency and to turn the waste energy of the vibrations into useful energy? In order to answer these questions, a mathematical model of non-linear differential equations was analyzed and solved and data on different types of control systems were compared and studied.

Mentor(s): Dr. Lei Zuo (Virginia Tech, Department of Mechanical Engineering), Feng Qian and Kan Sun, Department of Mechanical Engineering

MALLORY ALMAN
NC STATE UNIVERSITY/BIOLOGICAL & AGRICULTURAL ENGINEERING

Comparing Inactivation of Antibiotic Resistance Genes by Chlorination and Maturation Pond Treatment in Indian Wastewater Treatment Plants

Wastewater treatment plants (WWTPs) are known to frequently discharge antibiotic resistance genes (ARGs) into the environment, a practice which contributes to ARG transfer among environmental bacteria and aids the spread of antibiotic resistance. This study focuses on investigating the effectiveness of two disinfection methodsâ€"chlorination and maturation pondsâ€"in inactivating ARGs within two WWTPs in Chennai, India. Grab samples were taken before and after each treatment stage of the two plants. Microbial biomass from each sample was then concentrated by passage through three 0.22 Âµm filters to produce triplicate samples for DNA extraction. DNA samples from the secondary and final effluent of each plant were analyzed for concentration of genes 16S rRNA, intI1, and sul1 using quantitative polymerase chain reaction (qPCR). Non-parametric statistical tests will be used to determine whether ARG removal by chlorination and the maturation pond significantly differ. It is anticipated that chlorination will achieve higher removal of ARGs. While this specific study focuses on identifying disinfection technologies that lessen ARG presence, it also contributes to a three-year dataset that will be used by an international research team to determine factors promoting ARG dissemination in WWTPs worldwide.

Mentor(s): Dr. Amy Pruden (Virginia Tech, Civil & Environmental Engineering), 1. Ayella Maile-Moskowitz, Virginia Tech, Civil & Environmental Engineering 2. Abraham Cullom, Virginia Tech, Civil & Environmental Engineering

AHMED ALMATAR
THE PENNSYLVANIA STATE UNIVERSITY/MECHANICAL ENGINEERING

Ocean Wave & Solar Powered Saline Water Membrane Desalination

The world is currently experiencing a freshwater supply problem. About 97% of the water on earth is undrinkable saline water. The current distillation methods used to treat the saline water are energy-consuming and contribute to the world's high CO2 emissions. It has been realized that there is a potential in using ocean waves as an energy source to power the distillation process. However, an integrated approach using both ocean wave energy and solar energy is more desirable. A design was proposed to integrate both technologies. A three-float wave energy converter with solar panels fixed on top of the floats. This design allows for the use of both wave energy and solar energy simultaneously to desalinate saline water. Future work is to be done in developing the design further.

Mentor(s): Dr. Lei Zuo (Virginia Tech, Mechanical Engineering), Mr. Jia Mi, Virginia Tech, Mechanical Engineering

LAYLA ALMUALEM
VIRGINIA TECH /BIOLOGICAL SYSTEMS ENGINEERING

Enhanced Removal of Hazardous Azo Dye and Ammonia recovery from textile waste water by a Membrane Electrochemical Reactor

The industrial use of azo dyes is increasing worldwide due to the manufacturing of textile, leather, papers, and food. Therefore, the contamination of watersheds has increased distributing some activities in the ecosystem, and the need to remove these pollutants and maintain a healthy ecosystem lead to many studies resulting in several possible treatments for the wastewater. One of the most popular treatments is electrochemical oxidation, which can be direct or indirect. In our experiment, we use indirect EO which can be defined as a process to decontaminate aqueous solutions with methods involving homogeneous reactions with organic pollutants with strong oxidants generated mostly using active chlorine during electrolysis.

Mentor(s): Dr. Jason He (VT, Environmental Department)

ABDULLAH ALYAMANI
BOSTON UNIVERSITY/EARTH AND ENVIRONMENTAL SCIENCE

Synthesis of Nanoparticles as Sensors for Environmental Contaminants

In this research, an attempt to coat bacterial cellulose with gold nanoparticles and magnetite nanoparticles will be undertaken to further use this acquired material as sensors for some environmental contaminants. The process goes as follows: first, bacteria were cultured to grow their cellulose. Cellulose was acquired, and then magnetite was synthesized with the presence of this cellulose to coat it. The acquired magnetic bacterial cellulose was coated with gold nanoparticles through in situ reductions of gold ions in an incubator. Different concentrations were used in an attempt to optimize the final product. So far, the BC coated material was acquired successfully. However, it was not optimized yet, nor has it been tested as sensors.

Mentor(s): Peter Vikesland (Virginia Tech)

TREVOR AMESTOY
UNIVERSITY OF NEW MEXICO/CIVIL ENGINEERING

Quantifying peat hydraulic properties: a comparison of methods and peat layers to better understand consequences of drainage at the Great Dismal Swamp, U.S.A.

Peatlands provide important ecosystem functions, including long-term carbon storage, wetland habitat, and freshwater resources. Despite their importance, peatlands are impacted by anthropogenic disturbances. Peat soils provide water and carbon storage due to their unique hydraulic properties, but are particularly vulnerable to drainage via ditching, leading to increased fire risk, soil decomposition, and thus carbon loss. As such, accurate understanding of the hydraulic properties of peat soils and how they are affected by drainage is critical for informing wetland management decisions and restoration of historical water level regimes. Further, methods to assess hydraulic properties vary in measurement resolution and resource demands, prompting the need for comparative studies. An investigation was done on the hydraulic properties (water retention, hydraulic conductivity, porosity) of upper and lower peat soils of the Great Dismal Swamp (Virginia and North Carolina, USA), where past drainage is thought to have resulted in distinct peat layers. First, to compare methodologies, a combination tension-table and pressure plate extraction (TT/PPE) water retention method was compared to a more resource-intensive, higher resolution HYPROP automated method. Then the TT/PPE method, shown to be suitable, was used with upper and lower peat samples from three sites to assess hydraulic properties. Upper and lower peats showed distinct differences, particularly for water retention, suggesting upper layers are more vulnerable to dry conditions and associated fire and soil oxidation risk. This work highlights this important consequence of altered peat properties and supports future work needed to better understand feedbacks between hydrologic regimes and peat soil properties.

Mentor(s): Dr. Daniel McLaughlin (Virginia Tech, Forest Resource and Environmental Conservation), Clayton Word, Virginia Tech, Forest Resource and Environmental Conservation

KYLEA ANDREANO
VIRGINIA TECH /HUMAN NUTRITION, FOODS AND EXERCISE

Liver sinusoidal endothelial cells in non-alcoholic steatohepatitis

Non-alcoholic steatohepatitis (NASH) is the leading chronic liver disease in the US and will be the leading cause for liver transplants by 2030. NASH is characterized by the accumulation of fat in the liver in individuals who drink little or no alcohol. The mechanism of NASH pathogenesis is not fully understood. However, hypoxia or low oxygen, has been hypothesized to be involved. Hypoxic conditions increase reactive oxygen species (ROS) which regulate multiple cellular functions like migration. In order to develop novel therapeutics, the mechanism of NASH progression needs to be unearthed. This project aimed to discover the responses of liver sinusoidal endothelial cells (LSECs) to stress and the role of ROS in these processes. LSECs are unique in comparison to endothelial beds because they are â€œleakyâ€ù or extremely permeable to allow passage of solutes. Given that LSECs are distinct from other endothelial cells, it is of keen interest to uncover their response to hypoxic conditions. To investigate the role of ROS in LSEC function, cell migration, a typical response of endothelial cells to hypoxia was observed. Cells were infected adenoviral catalase (Ad-Cat) a powerful antioxidant enzyme that efficiently eliminates ROS, or with a control adenovirus, green fluorescent protein (Ad-GFP) for 24h. Cells then underwent a 12h hypoxia treatment (1% O2). Preliminary data suggest that migration was inhibited among the hypoxic control (GFP) group. Cells infected with catalase preserved migration and mimicked the normoxic group. These findings indicate that lower levels of ROS could preserve LSEC endothelial migration in hypoxic conditions.

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

MICHAEL ARNOLD
KENT STATE UNIVERSITY/BIOTECHNOLOGY

Examining Herbicide Resistance & Use in the Poaceae Family

Through examining the Poaceae family we sought to understand its basis for genetic resistance to herbicides, and to understand how herbicides can be best used in the Poa family to manage a persistent weed, E. indica, commonly known as Goosegrass. Through field trials comparing different herbicidal formulations we looked to rectify the difficulty of efficient management of Goosegrass in Bermudagrass (C. dactylon x C. transvaalensis), while retaining a visually appealing stand of Bermudagrass. Management of Goosegrass has remained a difficult problem since the ban of MSMA in 2009. By extracting DNA from multiple different populations of varying herbicidal susceptibilities, we sought to expose the genetic differences between these varying levels of resistance. Using techniques of molecular biology as well as digital image analysis, we were able to glean information on primer specificity in P. annua as well as understand some best-management practices for Goosegrass.

Mentor(s): David Haak (Virginia Tech, Plant Pathology), Jeffrey Derr, Virginia Tech - Hampton Roads, Plant Pathology

ANISSA ASHRAF
VIRGINIA TECH /HUMAN NUTRITION, FOODS, AND EXERCISE

Medication Adherence, Health Behaviors, and Delay Discounting in Hormone Receptor-Positive Breast Cancer Survivors

Hormone receptor-positive breast cancer accounts for approximately 70% of all breast cancer diagnoses. After initial treatment, long-term nonadherence to adjuvant hormone therapies, as well as obesity, poor diet, and sedentary behavior, are risk factors for breast cancer recurrence. Delay discounting (i.e. devaluation of delayed outcomes) is a behavioral process used to evaluate how individuals value the future. Because the therapeutic outcomes of medication adherence and weight loss are inherently delayed, many patients who devalue future outcomes at a high rate may find these sustained behavior changes difficult. The purpose of this study is to examine the associations between delay discounting, HT adherence, obesity, and obesity-related health behaviors. Further knowledge on the association of these different behaviors can help create further interventions to reduce delay discounting within patients and increase our understanding of risk factors for cancer-related morbidity and mortality for improved breast cancer treatment. In the present study, hormone receptor-positive breast cancer survivors visited the laboratory and completed assessments of demographics, delay discounting, diet and exercise habits, health history, and drug/alcohol use. Data were analyzed using multiple linear regression models. In hormone receptor-positive breast cancer survivors (N = 85), preliminary and ongoing data collection suggest that greater delay discounting is associated with medication nonadherence and greater BMI (in both cases, $p < .01$). Further work is still be done to assess the association between medication adherence and the health behaviors of diet and exercise in the laboratory and online.

Mentor(s): Jeff Stein (Fralin Biomedical Research Institute)

PATRICIA ASIATICO
VIRGINIA TECH /CIVIL ENGINEERING

Effects of a Building's Expected Lifetime on its Environmental Impact

The building industry contributes about 40% of the world's carbon emissions. As climate change worsens, it is crucial that buildings are being designed to have a lower environmental impact to help reduce the threat of climate change. This project studies how the expected lifetime of a building affects its environmental impact and identifies the processes with the largest environmental impact in a building's life cycle. Two archetype buildings were used: an energy-efficient steel office building and a masonry building assumed to have been built in the late 1800s. The expected lifetime of the steel building is 50 years while the masonry building has an expected lifetime of 200 years. A process-based environmental Life Cycle Assessment (LCA) was performed for both of these buildings, quantifying environmental impact through various LCA measures such as global warming potential and acidification potential. There were significant differences between the operational energy of the two buildings and the masonry building had 16% less embodied energy than the steel building. Overall, designing a building to have a longer expected lifetime reduces its global warming potential by 20%. In future research, replacing and/ or repairing these buildings due to natural hazards can be included to better quantify the environmental impact of a building within its expected lifetime.

Mentor(s): Dr. Madeleine Flint (Virginia Tech, Civil Engineering)

COLIN BACIOCCO
YALE UNIVERSITY/GEOLOGY AND GEOPHYSICS
KESTREL OWENS
YALE UNIVERSITY/GEOLOGY AND GEOPHYSICS
ISABELLE LARGEN
YALE UNIVERSITY/GEOLOGY AND GEOPHYSICS

Invisible water quality: Identifying spatiotemporal variation in water chemistry and water resource perceptions in Stroubles Creek headwaters

Urban watersheds are complex socio-ecological systems that provide critical ecosystem services to urban populations. While it is well established that urban development changes water quality, the spatio-temporal variation of water quality and how residents perceive that quality is poorly understood. Stroubles Creek, a long-studied stream with urbanized headwaters in Blacksburg, VA, is an ideal testbed for advancing the understanding of water resources in urban landscapes. Increased specific conductivity due to runoff of road salts, fertilizers, and other chemicals into Stroubles is an emerging water quality issue with the potential to significantly impair in-stream ecosystem functions. Stroubles' location on Virginia Tech's campus makes it highly visible, visited, and discussed among students and residents. We categorized one year of Instagram photos (n = 950) geotagged to the campus Duck Pond to determine how the frequency and nature of posts may relate to both water quality and how the public utilizes common ecosystem services. We analyzed six years of water quality data, collected high-frequency samples for one summer thunderstorm, and on one day sampled ten sites throughout the watershed. Samples were tested for ions, nutrients, carbon, and suspended solids. We found runoff pulses from distinct sub-catchments affected water quality differently. Furthermore, within the top 30th percentile of high discharge events ranked by volume we saw flushing events (early peaking measurements) occurring uniformly for specific conductivity in every season but summer. Finally, we hypothesize that because many water quality markers are invisible there is little to no relationship between social media posts and water quality.

Mentor(s): Cully Hession (Virginia Tech, Biological Systems Engineering (Hession and Krometis), Crop and Soil Environmental Sciences (Badgley)), Leigh-Anne Krometis, Virginia Tech (lehenry@vt.edu); Brian Badgley, Virginia Tech (badgley@vt.edu))

AMANDA BARNES

The Indirect Effects of Urban Development on Stream Biota

The purpose of this research was to determine any correlation between varying land usage and Virginia Save our Streams (VASOS) metrics. This research shows connections between how the land is developed and its indirect effect on stream biodiversity and therefore, level of impairment. Seven streams were assessed in this study. Each stream was surrounded by land being used in a different way, i.e. areas of high urban development, areas of light urban development, areas used for crops and/or hay, and heavily forested areas. At each site a Virginia Save our Streams survey was conducted. To do this a D-frame dip net was used. At various riffles in the stream the net was placed in the substrate of the stream. Rocks upstream of the net were overturned for a thirty-second-time interval. The net was then removed from the stream, the contents placed in a container, and the macroinvertebrates sorted and counted. Approximately 200 organisms were collected from each site, this is the recommended number by the Virginia Save our Streams method. A habitat assessment was completed at each site as well. Basic water quality parameters were also measured including pH, specific conductance, dissolved oxygen levels, and water temperature. A regression was completed for each of these measurements to show any correlations. The highest correlations were between VASOS with specific conductance, and VASOS with percent impervious surface. This information will be used as a framework for the watershed lesson in my classroom.

Mentor(s): Daniel McLaughlin (Virginia Tech, Forest Resources and Environmental Conservation)

CHRIS BARNES

valuating the role of draw solute selection in forward osmosis wastewater processing

Municipal wastewater streams represent a low-cost and under-utilized source of chemical nutrients, with potential for use as a feedstock for microbial fuel cells (MFC). However, the organic material and nutrient concentration can be low, which can reflect in the MFC's performance. This study aims to develop a forward osmosis (FO) cell and implementation protocol capable of receiving a wastewater stream, concentrating those nutrients, and recovering water; Reverse solute flux was also studied to understand solute movement during different operation times A 3D-printed forward osmosis cell has been designed utilizing a cellulose triacetate membrane to mediate water exchange between the feed (deionized water) and draw (1 M magnesium chloride, monobasic potassium phosphate, and ammonium bicarbonate) solutions. For 6-hour operation times, the average water flux for MgCl2, KH2PO4 and NH4HCO3 draw solutions were 12.52, 8.03, and 10.66 LMH, respectively. In regard to water recovery, this indicates that MgCl2 is the optimal choice for operating the cell in a batch process configuration. The results when the feed was replaced with filtered anaerobic digester effluent (ADE) showed a decreased average water flux (5.37 jLMH) and an increased average RSF compared to when the feed was deionized water. This response is most likely due to membrane fouling and chemical composition of the ADE. This approach presents a greater understanding of RSF in the production and scaling of FO cells for batch-processing, experimental use, as well as a viable means of concentrating wastewater for further work within the larger project. This research is a component in a larger project aimed at developing a more efficient, effective, and lower cost means of concentrating wastewater for use as a chemical feedstock for microbial fuel cells. One potential roadblock is the dilute nature of those nutrients as typically found in wastewater effluent. Goals are monetary efficiency, ease of implementation, and efficacy of the derived protocol for operating the cell. Pursuant to this, magnesium chloride, potassium phosphate, and ammonium bicarbonate have been tested as draw solutes in the cell, with an aim to discern which choice induced the greatest osmotic pressure necessitating the movement of water from the feed (wastewater) side of the cell to the draw (aqueous solute) side. By optimizing the draw solute choice, our project aims to create ideal water draw from the waste stream, resulting in the greatest concentration of solutes in the processed wastewater. Data from our work indicates that magnesium chloride is the optimal choice for operating the cell in a batch process configuration. This work presents a narrow focus of this overall project, a piece in which we worked to develop an internal protocol to work with a newly designed, 3D-printable forward osmosis cell.

Mentor(s): Jason He (Virginia Tech, Civil and Environmental Engineering)

AUSTIN BATZ
COLLEGE OF WILLIAM AND MARY/PHYSICS

Data Analysis of (e,e'p) Argon and Titanium Electron Scattering

This analysis addressed comparing the data of (e,e'p) observation in Jefferson Lab Hall A experiment E12-14-012 to Monte Carlo (MC) models. The results include comparisons of the data and the MC distributions of various kinematical variables where the background has been removed from the data. The distributions are scaled based on the charge of the incident electron beam, as well as the efficiency of the detector. The background subtraction improved the data-MC agreement, and the absolute scaling revealed that factors not yet accounted for such as final state interaction (FSI) depend in part on the shell of the nucleus struck by the incident electron. Completion of the analysis of the efficiency and full systematics will provide a viable nuclear model of neutrino scattering on argon, which will benefit future long-baseline neutrino experiments such as DUNE.

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

SHAWN BECKER

Dissolved oxygen levels as a factor in determining the health of freshwater ecosystems

One important way to assess habitat suitability for organisms in aquatic ecosystems is through measuring dissolved oxygen (DO) levels, DO consumption through respiration, as well as how DO fluctuates over time. Rapid-assessment measurements of biological oxygen demand using MiniDOT DO logging sensors were conducted in freshwater ecosystems draining various land uses in the New River Valley. Current methods used to assess freshwater ecosystem health from water quality rely on â€œsnapshotâ€ù DO measurements, long-term sensor deployments, or laboratory biological assays. Biological oxygen demand assays in the lab create unrealistic environmental conditions that limit our understanding of ecosystem health. Thus, the objective of this research was to test how characteristics such as land use, water temperature, and conductivity are related to DO concentrations and biological oxygen demand through short-term, on-site incubations of stream, pond, and river water. Respiration rates were calculated via the MiniDOT logging sensors in a water bucket collection method, and preliminary results have shown a linear regression in oxygen over time as waterways drain or transverse through agriculture or developed sites. Results are being used to develop long-term research protocols. Learning models for high school Ecology/Biology curriculum in conjunction with state SOL standards will highlight how measurements of water quality are related to biodiversity, and provide opportunities for students to develop and test hypotheses using online resources and data collection at local sites.

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

KATHERINE BERG
VIRGINIA TECH /BIOLOGICAL SCIENCES

Why accurate localization and expression of Amino Acid Permease1 in Arabidopsis plants is essential to assess its role in amino acid homeostasis?

Amino acid metabolism is finely tuned to carbon and nitrogen availability and to demand of the growing organs for organic nitrogen. Presently nothing is known about the early steps of regulation of amino acid metabolism, namely amino acid sensing. Amino Acid Permease1 (AtAAP1) is the best characterized amino acid transporter from plants, with an accepted role in amino acid uptake by the root. Disruption of AtAAP1 leads to plants that are tolerant to toxic concentrations of amino acids, supposedly by reducing amino acid uptake by the root. Results from our lab suggest that AAP1 is involved in amino acid sensing rather than uptake. In this new model, disruption of AAP1 alters amino acid signaling, affecting amino acid metabolism and translocation, which would explain the amino acid tolerance of the corresponding mutant. The aim of this project was to (1) precisely define the localization of AAP1 expression in the plant, and (2) test whether expression of AAP1 in specific cell types complements or not the phenotype of the aap1 mutant plants. For this purpose, the aap1 knockout mutant was transformed with several constructs leading to the expression of the GUS reporter gene or the AAP1 gene under the control of four promoters, specific of various cell types. So far, our results suggest that the expression of AAP1 in the root apical meristem, but not in the root cortex/epidermis (where amino acids are taken up), is critical for amino acid susceptibility, supporting our new model.

Mentor(s): Guillaume Pilot (Virginia Tech, School of Plant and Environmental Sciences)

GRISHMA BHATTARAI
HOLLINS UNIVERSITY/ECONOMICS, MATHEMATICS

Giving Power Back: Gender Smart Assistance to address Food Insecurity in Ethiopia

Food insecurity exists when all people at all times cannot physically and/or economically access adequate, safe, and nutritious food to meet their nutritional requirements for healthy living. Women, despite being the dominant gender group in rural Ethiopia with significant contributions to food production, preparation, and provision, are often the most vulnerable gender group to food insecurity and its obstacles. They are predominantly at a disadvantaged position when it comes to dealing with challenges of food security in rural Ethiopia. In efforts to combat Ethiopia's food insecurity, the government and international organizations have been working on all fronts, one of which is to provide food and/or cash assistance to rural communities. Despite policies and provisions of assistance, the gendered dimension of food insecurity leads us to question the difference in the effectiveness of assistance in male-headed households (MHH) and female-headed households (FHH). Does assistance affect MHH and FHH differently in its goal(s) of tackling food insecurity in Ethiopia? The novelty of this research is in looking at how assistance can (or, cannot) be gendered in collaring issues of food insecurity in Ethiopia. Consideration of the gender dimension while studying the harms of food insecurity is, therefore, significant in creating better, more gender smart policies on provisions of assistance. Using, the Ethiopia Socioeconomic Survey as the primary source of quantitative data, the analysis looks at food insecurity as a function of gender and assistance to understand assistance effectiveness in tackling food insecurity in Ethiopia.

Mentor(s): Dr. Kelly Cobourn (Virginia Tech, The Department of Forest Resources and Environmental Conservation)

BRYAN BLOOMFIELD
MOREHOUSE COLLEGE/PHYSICS

Characterizing harmful algal blooms (HABs) below the water surface using unmanned systems and underwater GPS

Harmful algal blooms (HAB)s, caused mostly by toxic cyanobacteria, naturally occur in freshwater systems. HABs may produce cyanotoxins that can affect the nervous and respiratory systems of humans. HABs may be fueled by agricultural runoff following major weather events such as hurricanes. The treatment of the HABs may cause the cells to lyse, releasing more cyanotoxins into the surrounding environment. Little is known about the transport of HABs below the water surface. We hypothesized that a HAB extends meters below the water surface. To test this hypothesis, we used coordinated unmanned systems in the air and water to determine the extent of a fluorescent dye plume (a surrogate HAB). A drone captured images of the dye at the water surface, an underwater vehicle was equipped with an underwater GPS system and a dye-tracking sensor to quantify the extent of the plume underwater (concentration, time, latitude, longitude, and depth). Our goal is to use this coordinated system in Ohio, USA in August 2019 to characterize a real HAB below the water surface.

Mentor(s): David Schmale (Virginia Tech, School of Plant and Environmental Sciences)

MAAME-OWUSUA BOATENG
NORTHERN VIRGINIA COMMUNITY COLLEGE/NEUROSCIENCE

Connexin43 Increases its Hemichannel Activity after Traumatic Brain Injury

Every year, around 1.7-3.7 million Americans experience traumatic brain injury (TBI) with 10-50% of patients subsequently at risk for developing epilepsy. Patients often respond poorly to surgery or anti-epileptic drugs that target neurons, resulting in long-term disabilities or death. Stopping the process that leads to the modification of the neural circuits leading to the epilepsy is a goal for the clinical and scientific community. Several studies have demonstrated that astrocytes are active drivers of the epileptic process. Astrocytes are coupled by and communicate via gap junctions, of which Connexin43 (Cx43) is a major component. This coupling is thought to counteract neuronal hyperactivity. In fact, impairments in the astrocytic coupling are contributing to several types of epilepsy. Cx43 can form hemichannels, free non-junctional channels that are generally closed but can open under pathological conditions, releasing neurotoxic molecules. Preliminary studies in our lab, suggested an increase in Cx43 after TBI associated to a shift from junctional Cx43 to non-junctional Cx43. Therefore, we hypothesized that after TBI, there is an increase of Cx43 hemichannels activity that favors the epileptogenesis through the release of excitatory components. We tested this hypothesis by using Ethidium Bromide (EtBr), a small fluorescent molecule permeable through the hemichannels in mouse brain slices. To determine whether the EtBr uptake was specifically due to the action of Cx43 hemichannels, we use specific inhibitors of Cx43 function. Our results showed that Cx43 hemichannels activity was increased in TBI mice, having a higher uptake of EtBr. Furthermore, the use of the distinct inhibitors revealed a significant contribution of Cx43 hemichannel activity to this increase in EtBr uptake. In conclusion, we found an increase in Cx43 hemichannel activity after TBI that can be contributing to the epileptogenesis after a TBI event.

Mentor(s): Maria del Carmen Munoz Ballster (Virginia Tech, Neuroscience)

UDIPTA BOHARA
HOLLINS UNIVERSITY/BIOLOGY

Viability of Eastern and Western North American Mycoplasma gallisepticum Strains on Birds Feeders

Mycoplasmas are pathogens that lack a cell wall, which increases its sensitivity to survival when outside the host body. Mycoplasma gallisepticum (MG), a pathogen of poultry and wild finches, is known to remain viable for short periods of time on birds feeders impacting their transmission. In finches, MG causes periocular swelling, ocular and nasal discharge, and impaired vision, and the severity of these effects can vary across MG strains. To test the difference in the viability of strains on feeder surfaces, MG strains isolated from California (2006) and Virginia (1994) were compared through detection of RNA and DNA on feeder ports with the help of quantitative PCR. Over eight time points (0-48 hours), MG was investigated on replicate feeders hung in bird cages under ambient environmental conditions in Blacksburg, Virginia. We hypothesize that the viability of MG will be lower in California (2006) than in Virginia (1994). We will discuss our results and the possible insights they give us for the evolution of pathogen virulence and the ability of MG to sustain itself within bird populations in different regions.

Mentor(s): Dana Hawley (Virginia Tech, Biological Sciences)

SAMANTHA BOND
VIRGINIA TECH /BIOLOGICAL SYSTEMS ENGINEERING

DR-ESC-Derived Endothelial Cells and Pericytes Interaction with Types III and IV Collagen

During vascular development, endothelial cells synthesize and interact with extracellular matrix (ECM) proteins such as Types III and IV Collagen (Col-III and Col-IV, respectively). Specialized cells that stabilize new vessels, known as pericytes, produce and physically engage these collagens, which in turn regulate their long-term investment during vessel formation. Here, we determined the levels of ECM protein production at specific time points after differentiation by performing quantitative reverse transcription polymerase chain reaction (qRT-PCR) on mRNA collected from differentiated mouse â€œdouble-reporterâ€ù embryonic stem cells (DR-ESCs). Briefly, these DR-ESCs posses fluorescent labels for endothelial cells (Flk-1:eGFP) and pericytes (Ng2:DsRed), and form primitive blood vessels over 5 to 12 days of differentiation. From these early-stage vascular networks, we found that the relative level of Col-IV transcripts (Col4a4) was stable, but the relative amount of Col-III (Col3a1) transcription exponentially increased from differentiation day 4 to day 9. The timing of this increase coincided with a steady increase in vascular complexity as measured by vessel area and branch point density. These data suggest that Col-III is likely an important component in the formation of the vascular basement membrane and may be integral to normal blood vessel development. The precise functional role of Col-III however remains unknown but will be explored in future work.

Mentor(s): John Chappell (Virginia Tech, Biomedical Engineering and Mechanics)

MAITLAND BOWEN
UNIVERSITY OF MICHIGAN/PHYSICS

Inverse beta decay and coherent elastic neutrino nucleus scattering -- a comparison

Many neutrino experiments involving low-energy neutrinos rely on inverse beta decay (IBD), including those studying neutrino oscillations at nuclear reactors, and for applications in reactor monitoring and the detection of neutrinos emitted from spent nuclear fuel. IBD reactions can occur only for electron antineutrinos with energy above a threshold of 1.806 MeV. Below this threshold, the signature of neutrinos is accessible via coherent elastic neutrino-nucleus scattering (CEvNS), a threshold-less reaction. CEvNS was observed for the first time in 2017 at 6.7-sigma confidence level after forty years of experimentation, albeit with neutrinos of about 10 times larger energy than those from reactors. Here we assume also that neutrinos from reactors and other MeV-sources eventually will be detected using CEvNS. This paper computes the spectra of uranium-235, uranium-238, plutonium-239, and plutonium-241, and determines and compares neutrino detection event counts using either IBD or CEvNS. This characterization will inform future detector choices and is directly applicable to various neutrino sources, including reactor neutrinos, spent fuel neutrinos, and geoneutrinos. The result is potentially useful in monitoring spent nuclear fuel and reactors, in support of nuclear nonproliferation safeguards objectives.

Mentor(s): Patrick Huber (Virginia Tech, Center for Neutrino Physics)

MAGGIE BOYER
VIRGINIA TECH /BIOLOGICAL SYSTEMS ENGINEERING

Uterine Fibroid Ablation Using Histotripsy: A Proof of Concept Study

Histotripsy is a non-invasive, non-thermal, Focused Ultrasound (FUS) ablation method that destroys tissue via precisely controlled acoustic cavitation that generates a â€œbubble cloudâ€ù within a focal region. This study focuses on performing proof-of-concept experiments to test the feasibility of using histotripsy for the treatment of Uterine Fibroids (UF), which are benign fibrous masses that grow in the uterus. To test the feasibility of histotripsy for this application, excised human UF samples were harvested after surgical procedures and were then treated with a 500 kHz histotripsy system using single cycle histotripsy pulses applied at 250 Hz. Results showed that histotripsy bubble clouds could be generated inside and on the surface of the targeted fibroids, but the treatments did not result in complete ablation of the targeted site after 2000 pulses/point, likely due to the dense collagenous composition of fibroids. Furthermore, damage was only visible on the surface of the tissue, as it was difficult to consistently generate a bubble cloud inside the extremely stiff tissue. Based on these results, a final set of experiments was conducted using a thermally-enhanced histotripsy method in which the fibroid samples were thermally pretreated to 90Â°C for four hours prior to histotripsy in order to reduce the stiffness of the tissue and make it more susceptible to histotripsy-induced damage. Preliminary results showed an increase in bubble cloud size, indicating a potential increase in tissue damage. Additional studies are ongoing to optimize the thermal pre-treatment and histotripsy pulsing parameters needed to achieve complete and efficient fibroid ablation.

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

AIDAN BRADLEY
VIRGINIA TECH /ENGINEERING
MICHAEL GOLDSWORTHY
VIRGINIA TECH /COMPUTER SCIENCE
XAVIER HARRISON
VIRGINIA TECH /CREATIVE TECHNOLOGIES
WALTER NEWSOME
VIRGINIA TECH /COMPUTER ENGINEERING
GEORGINA DZIKUNU
WSSU /BIOLOGY

Tracking of bat mobility and vocalizations near foliage

Bats that use echolocation to navigate can adjust their ultrasonic emissions which may lead to a better sensing performance. While there are countless studies observing bats flying through man-made obstacle courses in natural and lab environments, little is currently known about how these small mammals navigate the confusing habitats of undergrowth and foliage. To investigate the question of how bats use their abilities of echolocation to maintain quick and agile flight through such “cluttered” environments, we have implemented a an audio-visual array that consists of six GoPro cameras, placed strategically through a testing area, and four capacitive microphones on a rigid frame. This array was used to record the flight paths of bats along with their vocalizations as they flew. Array recordings took place in several locations around the Shandong and Heilongjiang provinces in China including the city of Acheng, the Shandong University campus, Mount Liantai, and the Niumaodong cave, allowing for observation of multiple bat colonies and their respective behaviors. Trajectory information from this study is used in concurrent study where a biomimetic sonar head is carried through flight paths, loosely matching those of low flying bats, to gather data resembling what a bat may hear while flying through its environment. It is anticipated that these results will inform the future development of a biomimetic robot with the abilities to behave like a bat in cluttered environments.

Mentor(s): Rolf Mueller (Virginia Tech, Mechanical Engineering), Nicole Abaid, Virginia Tech, Mathematics

SKEENS BROOKE
SOUTHWEST VIRGINIA COMMUNITY COLLEGE/PREMED AND AN ADVANCE IN SCIENCE

Evaluation of blood packed cell volume in cattle with and without Theileria orientalis Ikeda genotype

Mentor(s): Kevin Lahmers (Virginia Tech, Vet Med),

JASON BRUNO TERCEROS
VIRGINIA TECH /MECHANICAL ENGINEERING

Evaluating water quality impacts of urban runoff in Stroubles Creek using grab and continuous measurements

Human development and health revolve around having clean sustainable water systems as a reliable resource. To understand the reliability of a water body, water quality parameters are measured. Stroubles Creek provides a supply of water that could be fed by different land uses, which increases the chance of having variations in the quality of water. Both grab and continuous data measurement methods have been used to analyze basic water quality parameters such as: pH, turbidity, phosphate, nitrate, dissolved oxygen. Data collection has been done for both base flow and storm conditions and have been compared. These parameters are meant to reveal how the water is affected from the land use through the runoff. The purpose of the research is to determine how the urban water runoff during times of precipitation can add unwanted chemical mixtures in Stroubles Creek. In order to find these water quality comparisons, a low-cost water monitoring kit is utilized as a standard bases for gathering water parameters in the grab form in both flow conditions. The goal is to find the accuracy of such low-cost water quality monitoring kits by comparing its results to results of more sophisticated water quality sensors such as the Water Quality Multiprobe (Sonde). The data points were taken in various days to better compare the results to the sonde results. The results will show the importance of monitoring water quality parameters in urbanized waterways.

Mentor(s): Dr. Vinod Lohani (Virginia Tech, Engineering Education), Mohammad Yunus Naseri, Virginia Tech, Department of Civil Engineering

KATIE CAPPS
VIRGINIA TECH /MICROBIOLOGY

The role of GumN in infection by phage 7-7-1

Agrobacterium is a soil-dwelling bacterium that causes tumors in plants. These tumors stunt the plant's growth, kill tissue and roots, and attract harmful pests (i.e. earwigs) that burrow into the tumors. This causes the plant to not grow or die, which decreases yields in common crops like legumes and grains. In this project we explore how bacteriophage 7-7-1 infects a strain of Agrobacterium. This is important because it will broaden our knowledge of how bacteriophages infect their hosts, which allows us to utilize this information for phage application in agricultural settings. Agrobacterium sp. H13-3 has a gene called gumN that in other systems codes for a protein involved in polysaccharide biosynthesis. Previous research has shown that lipopolysaccharide (LPS) is essential for infection of Agrobacterium by phage 7-7-1. GumN could be creating a component of the LPS chain or could interact with other proteins involved in this biosynthesis pathway. We hypothesize that GumN is important for synthesizing building blocks in the LPS that phage 7-7-1 uses during infection of Agrobacterium sp. H13-3. To test this, we created a ΔgumN strain of Agrobacterium sp. H13-3 and analyzed this strain to see if it was still infected by phage 7-7-1 via liquid infectivity assays. We found that the ΔgumN strain was still sensitive to infection by phage 7-7-1. This shows that GumN is not necessary for phage 7-7-1 infection. However, it is still possible that GumN has a role in polysaccharide production. The function of this gene will be subject of future research.

Mentor(s): Birgit Scharf (Virginia Tech, Microbiology)

MELISSA CARR

Investigation of Copper Speciation, Complexation, and Precipitation in Drinking Water Systems through Bench Scale Testing and Field Sampling

Copper (Cu) is known to have antimicrobial properties, with cupric ion (Cu2+) being the most biocidal form. However, Cu2+ ions either released from Cu pipe corrosion or purposely dosed into water (e.g., copper-silver ionization) are readily precipitated at higher pHs and can be complexed by natural organic matter (NOM) and phosphate-based corrosion inhibitors (PO43-), which reduces Cu biocidal capacity. Identifying environmental conditions that will decrease or negate the biocidal capacity of Cu2+ is important so that informed decisions can be made when selecting a water management program to prevent exposure to Legionella bacteria. Independent batch reactors were used to examine the impact of pH (6, 6.5, 7, 7.5) and PO43- (0.5 mg/L as PO43-) on the speciation and relative concentration of Cu (from 10 ppb to 500 ppb). Increasing pH above 7.5, resulted in Cu2+ ion concentrations <11.6% of the total Cu dosed. Likewise, addition of 0.5 mg/L PO43- at pH 7.0 decreased Cu2+ to < 30.6% of total Cu. These trends were confirmed in three independent drinking water systems with pH 6.7-8.3, monochloramine and free chlorine secondary disinfectants, and PO43- from .15 - 1.45mg/L. Cu2+ is significantly reduced by increasing pH alone, but the effects are magnified with addition of PO43- and the addition of natural organic matter (NOM).

Mentor(s): William Rhodes (Virginia Tech, Civil and Environmental Engineering Dept.), Yang Song, Virginia Tech, Civil and Environmental Engineering Dept

MALLORY CERKLESKI
GUILFORD COLLEGE/SUSTAINABLE FOOD SYSTEMS

Soybean Yield and Quality: Mapping Genes Controlling Protein and Ensuring Ample Soil Sulfur Fertility

Soybean is an important crop in the United States with annual value of 40 billion dollars. Therefore two projects were completed, one basic and one applied, to try and boost the success of this industry in different ways. The basic project's goal was to help develop DNA markers to be used for marker-assisted selection to select for high protein soybean lines. In order to locate and characterize protein content, scientists developed DNA markers to construct genetic maps to identify corresponding regions on chromosomes that control protein content. Using markers accelerates the breeding process for high protein cultivars; which is important to more efficiently feed the world. Correlation analysis between protein values and SNP markers linearly placed on the genetic map allowed chromosomal regions associated with protein content to be determined. We selected 16 SSR markers to develop additional markers closely located to protein hot spots and for other non marker-dense chromosomal regions. It was seen that three and two SSR markers mapped on chromosomes 2 and 15 respectively were tightly linked to protein controlled regions. The applied project's goal was to develop sulfur (S) application rates and sources to reduce S deficiencies for soybean (Glycine Max L.). Sulfur deficiency is more prevalent in the United States due to the passing of the Clean Air Act in 1963 which reduced sulfur dioxide (SO2) emissions and subsequent wet S deposition via acid rain on farmland. Prior to emission regulations, acid rain would deposit â€œfreeâ€ù S, approximately 15-40 lbs. ac., to soils sufficient for crop production. Compounding decreased â€œfreeâ€ù S deposition, increases in crop yields, potential for plant available S form sulfate (SO42-) to leach on coarse textured low organic matter soils, and failure to replenish S via synthetic fertilizer sources has led to S deficient cropping systems. Specifically, oilseed crops like soybeans, with higher protein percentages than cereal crops, require sufficient S (R2 0.2-0.5% S) for nitrogen fixation and biochemical plant processes. In order to ensure high soybean quality and yield in the future, it is vital to identify adequate S source, rate, and timing to support maximum plant productivity. Therefore, applied soybean field trial objectives were outlined to determine: 1) Sulfur source (Ammonium Sulfate, Potassium Sulfate, Calcium Sulfate, and Elemental S) effect upon early soybean (R2) S tissue concentrations and 2) S rate influence upon vegetative (R2) S concentrations. Both projects combine to boost soybean quality and production through genomic selection and increased plant nutrition via adequate soil fertility. Genetic selection aided in determining chromosomal regions (2 and 5) influencing soybean protein content. Applied soil fertility field trials identified adequate S sources and rates to ensure optimum soybean production across the Commonwealth and more importantly fulfilling soybeans genetic potential.

Mentor(s): Saghai Maroof (Virginia Tech), Mark Reiter, Virginia Tech, mreiter@vt.edu

BRANDON CHRISTENSEN
VIRGINIA TECH /AEROSPACE ENGINEERING

Space Simulation Survey: Leading Developments Towards Using Multi-Rotors to Simulate Space Vehicle Dynamics

With the development of space technologies accelerating, it has become increasingly important for researchers to conduct studies of a space environment both accurately, and in a cost-effective manner. Considering the high costs of conducting tests in orbit, over the past several decades, there has been significant development in Earth-based space simulations. Primarily, these simulations have focused on studying the vacuum conditions of space as well as the effects of radiation and micro-meteor impacts on materials and spacecraft. Although necessary, there is the issue that many of the physical space environment simulators in existence today do not simulate the weightlessness spacecraft experience in orbit. Recent developments in drone technology, specifically in multi-rotor drones, may allow for the simulation of weightlessness on Earth. This may allow for the behavior of bodies in a weightless environment to be studied to develop improved methods to predict a satellite's motion in zero-g environments. Following thorough research, in this presentation, there will be an overview of the physical space environment simulators several organizations and companies have developed, as well as an outline of the possibility of using multirotor drones to simulate zero gravity environments and future research that can be conducted in the space environment simulation field.

Mentor(s): Daniel Doyle (Virginia Tech, AOE)

JESSICA CHRISTIAN
UNIVERSITY OF MARYLAND, BALTIMORE COUNTY/PHYSICS

Maximizing the KURF materials screening sensitivity with a cosmic ray veto

Secondary muons are extremely penetrating, near-lightspeed particles found in cosmic rays. They are a major source of high-energy background interference for Virginia Tech's high-purity germanium (HPGe) detector housed at the Kimballton Underground Research Facility (KURF) in Ripplemead, VA. Though muon interference is partially shielded by the rock overburden at KURF, our team works to integrate the HPGe detector with a two-layer muon detector to veto persistent radiation caused by muon events. After fitting the muon detector to the physical specifications of the lab site, we used the HPGe present in-house at Virginia Tech and a sodium iodide scintillator to progressively modify the detector readout system, including applying remote controls, using a logic gate redundancy to increase efficiency, and selecting an increased photoelectron threshold for the muon detector to remove low-energy interference. Before installation at KURF, we found muon-energy peaks in spectra from samples containing known sources to have decreased to less than one count per day above 4 MeV, the range where our data is taken. Ongoing features of this research include analyzing data taken on location at KURF to further improve the integration and subsequently using the integrated detectors to observe radioisotopic sample backgrounds in high-purity environments.

Mentor(s): Thomas O'Donnell (Virginia Tech, Physics)

CANACE CHUNG
AMHERST COLLEGE/MUSIC

Analysis of Microglia Morphology and Distribution in Visual Cortex of Control Rats and Rats with Mild Traumatic Brain Injury

Our laboratory has found that mild traumatic brain injury (mTBI), in parietal cortex affects synaptic plasticity in the primary visual area of the ipsilateral occipital cortex. In addition to such neuronal effects, it is also known from other studies that microglia respond to various insults such as infection or injury. Thus, we set out to evaluate whether in addition to the synaptic effects, concomitant changes in microglia occurred in response to mTBI. We used a series of morphological criteria to evaluate the structure of microglia. Specifically, we designed an experiment to compare the structure of microglia in the brain after mTBI as compared to controls. We examined the total process length and complexity of profiles identified by immunohistochemical labeling with an antibody to ionized calcium binding adaptor molecule (Iba1). Rats were separated into one of three groups (control, sham operated, mTBI by controlled cortical impact) at 8-9 weeks of age. Two weeks later (10-11 weeks of age), rats were deeply anesthetized with ketamine/xylazine and perfused, and had their brain removed, post-fixed in 4 % paraformaldehyde and cryo-sectioned. Free floating sections (30 um) of visual cortex were processed for immunohistochemistry (IHC) using primary antibody anti-Iba1 (1:500) and fluorescent secondary antibody (Alexa Fluor 594, 1:000). Sections were imaged using a Zeiss 710 confocal microscope (40x oil). Images were analyzed using Fiji Image J and Microsoft Excel. We measured microglia density, soma area, number of primary processes, as well as total process length and complexity (Sholl analysis) across all groups, in order to obtain quantitative measures of microglia morphology and distribution. For the control, sham, and mTBI groups, we found that the cell density (396.12 Â± 11.77, 443.93 Â± 30.79, 425.64 Â± 17.36 positive cells/mm2), soma area (39.67 Â± 1.81, 46.80 Â± 4.92, 46.21 Â± 2.70 um2), and number of primary processes (4.14 Â± 0.28, 4.27 Â± 0.33, 4.45 Â± 0.13) was not significantly different (p= 0.22, 0.63, 0.22; p= 0.25, 0.92, 0.10; p= 0.77, 0.65, 0.37, Student's t-test). However, we did find a significant difference in the mean total length of the processes emanating from the microglia somata with the mTBI group having significantly more extensive lengths of processes than either the un-operated controls (p=0.016, Student's t-test) or the sham controls (p=0.002, Student's t-test) (mTBI mean process length = 351.36 um Â± 19.83 sem um; control mean process length = 159.18 um Â±44.49 sem um; sham mean process length = 196.66 um Â±22.14 sem um) while the un-operated controls' mean process length and the sham controls process length were not statistically different (p=0.49, Student's t-test). These results indicate that mTBI affects the spatial coverage by microglial processes, at least in layer 2/3 of the primary visual occipital cortex to an earlier mTBI in the ipsilateral parietal cortex. Whether these effects have any relationship to the other findings of the lab with respect to mTBI on synaptic function in this same area cannot be determined from this study. Moreover, the mechanisms responsible for this elaboration of microglial processes must await additional experiments.

Mentor(s): Michael Friedlander (Fralin Biomedical Research Institute, Neuroscience), Quentin Fischer, Susanna Kiss, Hodja Kalikulov, Fralin Biomedical Research Institute

LEOR CLARK
VIRGINIA TECH /BIOLOGY

Evidence for Connections Between Flavonoid Metabolism and the Circadian Clock in Arabidopsis Thaliana

Flavonoids are a group of metabolites unique to plants that play key roles in plant development, reproduction, and resistance to stress. These compounds also serve as a vital component in human health as key nutrients and as pharmaceuticals. Flavonoids are synthesized by an enzyme complex centered on chalcone synthase (CHS), which catalyzes the first reaction in the pathway. Previous RNA seq and qRT-PCR experiments in the model plant, Arabidopsis thaliana, showed that the CHS-deficient mutant line (tt4-11) has altered transcript levels for numerous genes associated with control of the circadian clock. Additional qRT-PCR analyses were performed to extend these initial findings, both in tt4-11 and a second allele, tt4-2YY6, as well as in the tt7-5 mutant line, which is defective in only part of the flavonoid pathway. These experiments aimed to determine whether it is the lack of flavonoids or lack of the CHS protein that is responsible for the observed alterations in the clock. Additional genes were also included in these analyses. To quantify the effects of altered flavonoid metabolism on the circadian cycle, luminometry was used to compare expression of two circadian clock reporter constructs, CCA1p::LUC and TOC1p::LUC in tt4-11 and wild type plants. Consistent with the earlier findings, both promoters exhibited altered cycle amplitude in tt4-11 seedlings, although there were no effects on phase or period. This link between flavonoids and the clock, already known in animals, has for the first time been shown in plants. This work thus has broad implications, from agriculture to human health.

Mentor(s): Brenda Winkel (Virginia Tech, Biology)

CHLOE COLEMAN
CONCORD UNIVERSITY/PSYCHOLOGY

Interaction Effects of Religion and Stress on Neural Cognitive Control in Adolescents

Prior research proposes that cognitive functions, such as cognitive control, are altered by stress (McEwen & Sapolsky, 1995). Religion has been found to increase self-control (McCullough & Willoughby, 2009) which may protect against stress effects. We predicted that greater levels of stress would be associated with worse neural cognitive control in the prefrontal cortex and that higher religiousness would act as a protective factor. The current longitudinal study analyzes the interaction of religion and stress on cognitive control. The sample consisted of 167 adolescents, age 13-14 years old at Time 1 (M=14.07, SD=0.54) and 16-17 years old at Time 4 (M=17.01, SD=0.54). Functional magnetic resonance imaging was used to measure blood oxygen level dependent (BOLD) responses in the brain during a multi-source interference task. Adolescents also reported on a perceived stress scale and religiousness questionnaire. Results indicated a significant main effect between stress and cognitive control (B=.09, p=0.04), higher stress at Time 1 predicted higher BOLD response (indicating worse cognitive control) at Time 4. The interaction effect of religiousness and stress was non-significant (B=-.01, p=0.55). The results suggest that reducing stress in adolescence may facilitate adaptive brain functioning in the prefrontal cortex. While religiousness was not found to alter the relationship between stress and cognitive control, it is possible there was no interaction effect due to the decline of personal religious views beginning in adolescence (Koenig, McGue, & Iacono, 2008). Future research for protective factors against stress effects in adolescents could examine the role of parent-adolescent relationships or emotion regulation.

Mentor(s): Jungmeen Kim-Spoon (Virginia Tech, Psychology), Alexis Brieant, Virginia Tech, Psychology

ERIN COLLINS
VIRGINIA TECH /BIOCHEMISTRY

In Silico Investigation of Multiligand Cobinding Activation in PPARÎ_ and its Natural Mutations

Peroxisome proliferator-activated receptor (PPAR) is a nuclear hormone receptor that regulates many functions in cell metabolism, such as adipogenesis and insulin sensitivity. Type 2 diabetes (T2D) is characterized by an insensitivity to insulin, prompting research into increasing insulin sensitivity through activating the gamma isoform, PPARÎ_, with a single agonist. However, it has been shown that PPARÎ_ can accommodate multiple ligands through simultaneous, cobinding activation. The mechanism of cobinding activation in PPARÎ_, the role of natural mutations on cobinding, and the implications of this process in drug design is largely unknown. Here, in silico techniques were used to investigate common pharmacophore features, differences in binding cavity volume, and the effects of six naturally occurring PPARÎ_ mutations (R288H, Q286P, V290P, F360L, R397C, P467L) on multiligand binding. Pharmacophore features varied between multi-ligand structures, implicating structural rearrangement based on the number of ligands present. Surprisingly, the predicted volume of the binding cavity remained consistent regardless of the number of ligands. Additionally, Q286P caused ligands to avoid the front of the binding cavity due to changes in the electrostatic properties of the area. R288H limited binding affinity in the middle and rear areas of the binding cavity, implicating its role in disrupting two and three ligand activation. This study expands our understanding of how PPARÎ_ naturally activates via cobinding activation and how natural mutations affect multiligand binding. Cobinding activation can be exploited to create more effective and predictable drugs to treat T2D.

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

CHRISTINA COMPTON
VIRGINIA TECH /HUMAN, NUTRITION, FOODS, AND EXERCISE

Antidiabetic Effects of Elenolic Acid in Vitro and in Vivo

Type 2 diabetes mellitus (T2DM), a substantial public health concern in the United States, is characterized by insulin resistance and pancreatic beta-cell dysfunction. The disease is currently affecting more than 30 million Americans with an estimated cost totaling over $245 billion for the United States alone (1). We have found that a low-cost, naturally occurring small molecule found in mature olives and extra virgin olive oil, elenolic acid (EA), effectively improved insulin sensitivity in diet-induced obese mice and insulin-stimulated glucose uptake in human skeletal muscle cells. However, the underlying mechanism is unclear.Â In this project, we used Chinese hamster ovary (CHO)-cells overexpressing human insulin receptor to study whether EA induces insulin signaling via activation of insulin receptors. In addition, we compared the antidiabetic effects of EA with two commercial T2DM drugs- metformin and liraglutide,Â in the leptin receptor knockout (db/db) mice. In vivo, db/db mice treated with EA exhibited improved glycemic control, which is comparable to the liraglutide-treated group. Moreover, EA administration reduced weight gain of the mice via food intake suppression.

Mentor(s): Dr. Dongmin Liu (Virginia Tech; Human, Nutrition, Foods, and Exercise)

HAMILTON CROCKETT
VIRGINIA TECH /AGRONOMY

Ice Nucleation Activity of Birch Trees in Different Seasons

Pollen, bacteria, and dust in the atmosphere may demonstrate ice nucleation activity (INA), meaning these particles have the potential to trigger ice formation at warmer temperatures. Some plant species, such as birch, have been shown to produce copious amounts of ice nucleating particles (INPs). However, little is known about the structure and function of INPs in plants. We tested the hypothesis that there is seasonal variation in the production of INPs in birch tissues. Samples of leaves, petioles, primary wood, secondary wood, bark and soil samples were taken from different trees in Blacksburg, VA. Samples were taken during three periods of from 2018-19: Pre-frost, Post Frost and Spring leaf emergence. The samples were analyzed for INA in a cryo-bath using 96-well plates. Samples will be further analyzed using a cryo-cell/peltier device viewed under a microscope. The leaf samples displayed the most dynamic freezing temperatures, with freezing temperatures from -6°C to -14°C. The wood samples froze around the same temperature with a mean of -10.5°C ±1.4°). The orientation (North vs. South) did not appear be a factor in the INA. However, bark samples froze at higher temperatures than the control. The mean bark freezing temperature was -6.4°C, compared to -8° for an INA strain of Pseudomonas syringae. Our work sheds new light on the seasonal variation in INPs in birch tissues, and could find future applications in the production of artificial snow and the freezing of food products.

Mentor(s): Dr. David Schmale III (Virginia Tech, SPES), Regina Hanlon, Virginia Tech, SPES

RACHAEL DAL PORTO
CALIFORNIA STATE UNIVERSITY, SACRAMENTO/CIVIL ENGINEERING AND CHEMISTRY

Effects of Water Quality on Aerosol Size and Number Concentration Distribution Emitted from an Ultrasonic Humidifier

Ultrasonic humidifiers provide indoor relief to symptoms caused by dry air through producing water vapor as well as aerosols containing both water and minerals that are present in the water used to fill the humidifier. Inhalation of these particulates can cause lung injury and intensify symptoms of asthma, colds, and other respiratory impairment. Knowledge is lacking for the size distribution and concentrations of emitted aerosols and particles due to effects of water quality, distance from humidifier diffuser, and vertical position relative to the plume. This project investigated the spatial distributions and concentrations of aerosols emitted when an ultrasonic humidifier was filled with distilled water, low mineral tap water, and high hardness water. Triplicate measures of aerosol sizes and counts were taken at six horizontal distances both in the plume and approximately 1 meter below the plume for each water quality. Results show that size distributions are statistically the same within each water quality and independent of horizontal or vertical distance from the diffuser. The mean count median diameters were 59 nanometers(nm) for distilled water, 124 nm for tap water, and 377 nm for hard water; the concentrations were 3,030,023/cm3, 35,701,652/cm3, and 50,360,463/cm3 respectively. Aerosol concentrations are statistically highest for tap and hard water at a horizontal distance of 0.3 meters and in the plume. Water quality affects the distribution and concentration of emitted aerosols, and therefore the inhalable indoor air quality, with distilled water emitting the fewest particulates and water with minerals emitting more and larger particulates.

Mentor(s): Dr. Andrea M. Dietrich (Virginia Tech, Civil and Environmental Engineering), Wenchuo Yao, Virginia Tech, Civil and Environmental Engineering

LANCE DE KONINCK
VIRGINIA TECH /ENGINEERING SCIENCE AND MECHANICS

Passive Anti-Frosting Cables via Microscopic Ice Patterns

The accretion of frost and ice on transmission and power lines can compromise their integrity and also poses a danger to surrounding infrastructure and people. We present a passive anti-frosting cable design that keeps the majority of the surface free of condensation and frost, effectively preventing a continuous layer of ice from forming. The design consists of an array of wicking micro-grooves machined into rings that are evenly spaced across the cable. Water preferentially forms within the grooves, which freezes into â€œice ringsâ€ù at cold temperatures. As ice exhibits a depressed vapor pressure relative to liquid water, these ice rings act as overlapping humidity sinks. Two supersaturations were tested, a supersaturation of 3 to best measure frost accumulation through video analysis, and a supersaturation of 1.5 to match environmental conditions. Our experimental results show that for the lower supersaturation, regions between rings remain dry for hours, even under chilled and supersaturated conditions. For the larger supersaturation tests, regions between rings grew considerably less frost than on the rings, and in some cases remained completely dry. In contrast, continuous sheets of frost grew on conventional cables, even when treated with a superhydrophobic coating.

Mentor(s): Jonathan Boreyko (Virginia Tech, Biomedical Engineering and Mechanics), S. Farzad Ahmadi, Virginia Tech, Biomedical Engineering and Mechanics

TANNER DEHART
VIRGINIA TECH /BIOCHEMISTRY

Characterization of an Essential Peptidoglycan Synthesis Enzyme in Borrelia burgdorferi, the Causative Agent of Lyme Disease

Lyme disease, caused by the spirochetal bacterium Borrelia burgdorferi, is the most common vector-borne illness in the United States. If left untreated, it can cause several debilitating conditions such as arthritis, paralysis, and potentially fatal carditis. Although increasingly prevalent in the United States, there is no cure, and treatment options consist mostly of broad-spectrum antibiotic courses. Like most bacteria, B. burgdorferi relies on penicillin-binding proteins (PBPs) to synthesize the structural component of its cell wall â€" the biopolymer peptidoglycan â€" made from repeating sugar and peptide subunits. Peptidoglycan is essential for bacterial growth and division, making it the perfect drug target. As their name suggests, PBPs are the target of Î_-lactam antibiotics, such as penicillin. A putative homolog to PBP2a in B. burgdorferi is of particular interest because it functions in the presence of Î_-lactam antibiotics in other bacteria, giving rise to organisms like methicillin-resistant Staphylococcus aureus (MRSA). Little is known about the PBPs of B. burgdorferi, despite their importance to cellular function and being the target for most currently used Lyme disease treatments. Here, we use molecular, cellular, biochemical, and surrogate-host studies to evaluate the function of a seemingly essential PG synthesis enzyme. Our studies will characterize the role of a putative PBP2a in B. burgdorferi to better understand its role in PG synthesis and antibiotic resistance/susceptibility. These studies on the essential peptidoglycan synthesis enzymes of B. burgdorferi allow molecular structure/function relationship(s) to be determined and lead to the discovery of more novel therapies in the treatment of Lyme disease.

Mentor(s): Dr. Brandon Jutras (Virginia Tech, Biochemistry)

ETHAN DORMAN
THE PENNSYLVANIA STATE UNIVERSITY/PLANT SCIENCE

Studying a Weed Pest, Observing Insect Pollinators and Pests, and Measuring a Fruit Quality Parameter in Agroscience Environments

One of the objectives of my program was to develop a protocol that will efficiently and reliably produce haustoria tissue from the parasitic plant Cuscuta. My study was part of a larger project to produce a genetically modified Cuscuta plant, which will aid research into the molecular biology of Cuscuta and parasitic plants in general, and hopefully provide insight into different mechanisms of host resistance to parasitic plants. Plant cuttings were secured around straws which acted as hosts and placed in boxes filled with a nutrient solution. Different media properties and hormones in two separate studies were used to influence the growth and development of haustoria. Liquid media produced higher quality haustoria than solid media. It is unclear if the addition of hormones had any effect. A second objective of my project was to observe insect pollinators, pests, and visitors on blackberry. Pollinators were collected by using an entomological net and walking through blackberry patches for 10 minutes per visit. Yellow sticky traps were also left in the field and collected after 1 week. A variety of insect species were collected and are currently being identified. The third objective of my program was to measure the effects of different soil disinfestation treatments on the sugar content of strawberry fruits. A mortar and pestle were used to obtain juice from the strawberry samples and a refractometer was used to measure the total soluble solids. Data from the trials suggests no significant difference in strawberry sugar content among treatments.

Mentor(s): James Westwood (Virginia Tech, Soil Plant and Environmental Science), Jayesh Samtani, Virginia Tech, Horticulture

LOGAN DUNKENBERGER
STANFORD UNIVERSITY

Novel Use of Resveratrol for the Therapeutic Induction of Epstein-Barr Virus Lytic Infection

Epstein-Barr virus (EBV) is a ubiquitous human herpesvirus that is strongly associated with several cancers, including lymphoma. While lymphomagenesis was previously thought to occur primarily during latent (non-replicative) EBV infection, we recently demonstrated that low-level lytic infection in the hypoxic tumor microenvironment promotes increased angiogenesis and vessel permeability. This results in a more aggressive tumor phenotype and contributes to chemotherapy resistance; thus, the identification of novel, virus-targeted therapeutics may improve clinical outcomes. The nucleoside analog acyclovir (ACV) has shown efficacy against lytic EBV infections, though our preliminary data suggest hypoxia-induced viral reactivation does not confer ACV sensitivity. Alternatively, artificial induction of lytic gene expression using sodium butyrate (SB) and phorbol 12-myristate 13-acetate (PMA) increased ACV activity, resulting in cancer cell death. These treatments, however, were associated with enhanced metastatic potential, as seen by upregulation of the viral oncogene LMP1, mediating cancer initiation and cell migration, and VEGF-A, facilitating increased vascular permeability and entry into the systemic circulation. Use of the phenolic compound resveratrol inhibited LMP1 and VEGF-A expression, reducing the potential for cell migration and angiogenesis. Resveratrol also increased expression of the viral lytic gene BGLF4, which initiates ACV monophosphorylation to improve overall treatment efficacy. Taken together, these data support a novel role for resveratrol in the therapeutic induction of EBV-associated cancers.

Mentor(s): John Chappell (Fralin Biomedical Research Institute)

GRACE DUNLEAVY
DRAKE UNIVERSITY/PHYSICS

The Impacts of Cosmic Ray Interactions on Dark Matter Detection

Dark matter detection is currently being explored using two different methods: direct and indirect detection. A third method, reverse direct detection, is being researched and relies on cosmic rays interacting with dark matter. This collision causes the previously slow dark matter to begin traveling relativistically. Standard direct detection methods can only detect heavier dark matter particles of masses of a GeV or more, travelling at approximately 200 kilometers per second, but with cosmic ray interaction, dark matter particles of smaller masses and higher velocities can be observed through these direct detection methods. This interaction between dark matter and cosmic rays produces an energy dependent cross section, which is used to determine the interaction lengths and energy loss lengths. By exploring the interaction between cosmic rays and dark matter, more can be learned about these interactions such as their cross sections, interaction lengths, and energy loss lengths for a variety of cosmic ray energies, including extragalactic cosmic rays of energies greater than 1020 eV. This project will examine the extent of the energy dependence on these characteristics of the interaction, and the impacts of this dependence. Models of these interactions can be plotted and compared to known standard model interactions, giving new information about these collisions at a variety of energies.

Mentor(s): Shunsaku Horiuchi (Virginia Tech, Physics), Ian Shoemaker, Virginia Tech, Physics

GEORGINA DZIKUNU
WINSTON-SALEM STATE UNIVERSITY/BIOLOGY

Survey of bat habitats in China

China's diverse natural environments are linked to a likewise diverse group of keystone species such as bats. Bats account for more than 20% of all mammalian species and their success is based on several factors that includes biosonar sensing; also known as echolocation. Bats emit soundwaves with high frequency and listen for the returns from prey and habitats. Predator and prey relationship of bats mostly rely on biosonar with behaviors that typically vary between species. In this study, we have surveyed potential bat habitats across northeastern and southwest China. During this survey, we have captured images of the habitats, recorded videos via a camera array to analyze flight patterns and recorded ultrasonic sounds using bat detectors, a microphone array, and a biomimetic sonar head. In addition, 3d scans of environments ranging from deciduous forests to temperate grasslands were collected using a laser scanner. This data can inform imitations of the intricate flight and sensing strategies of bats in different habitats. A biomimetic sonar head inspired by horseshoe bats allows us to understand the complex system that is biosonar and how it works in vegetation. Qualitative data from our survey also allows us to simulate habitats that bats are likely to roost, commute, and forage in. The availability of resources such as water, food, and shelter contribute to bat behavior, hence our goal to adequately understand types of environments and how a bat might inhabit an area.

Mentor(s): Rolf Mueller (Department of Mechanical Engineering, Virginia Tech)

MATTHEW EVERETT
UNIVERSITY OF TENNESSEE, KNOXVILLE/BIOCHEMISTRY

Elucidating CASK-Tubulin Interaction in Transfected HEK293 Cells

CASK is a membrane associated guanylate kinase (MAGUK) protein encoded by the X-linked CASK gene. With CASK being essential for proper central nervous system development, mutations in the CASK gene often result in neurodevelopmental disorders. Symptoms of CASK loss-of-function mutations in humans include microcephaly and pontine and cerebellar hypoplasia (MICPCH), intellectual disability, and ophthalmological disorders Previous research has shown that CASK interacts in a complex with cell surface proteins (e.g., neurexin) and cytoskeletal elements (i.e., actin filaments). However, it has not been characterized how interferences in CASK-cytoskeleton interactions via genetic mutations manifest in the phenotype. Therefore, we studied the putative CASK interaction with tubulin, the monomer of microtubules and an essential cytoskeletal element in cell division. We used immunoprecipitation and western blotting to investigate the CASK-tubulin interaction. Using confocal microscopy analysis of transfected fluorescently-tagged HEK cells, we used a membrane recruitment and colocalization assay suggesting that CASK interacts with tubulin. This research provides evidence that implicates CASK-tubulin in contributing to mammalian neurodevelopment and a possible target of interest while investigating CASK mutations and deletions that culminate in neurodevelopmental disorders. Further research is needed to show specific CASK domains binding tubulin and to characterize the contribution of CASK-tubulin interaction to CNS development.

Mentor(s): Konark Mukherjee (Fralin Biomedical Research Institute)

COLE FAULKNER
RADFORD UNIVERSITY/BIOLOGY

Quantifying effects of mild traumatic brain injury on the morphology and distribution of microglia in visual cortex

We examined microglia (brain-specific macrophage) morphology (cell density, somatic area, number of primary processes, somatic shape) and distribution (mean distance, nearest neighbor distance) in the visual cortex of naÃ¯ve control rats, sham operated rats, and rats that had received a mild traumatic brain injury (mTBI). Microglia function as immune response cells in the brain by relocating to the sight of inflammation within the tissue, which may change the cell density, somatic shape, and proximal distance between cells in tissue. Microglia are known to change their morphology and distribution in response to various insults to the brain. Previous work in our laboratory has revealed changes in synaptic plasticity in layers 2/3 of the primary visual area of the occipital cortex after mTBI in ipsilateral parietal cortex. We postulated that a spatially and temporally distant mTBI (in ipsilateral parietal cortex 2 weeks previous) will produce changes in the morphology and distribution of microglia in visual cortex. Twelve rats were segregated into three groups: un-operated controls, sham controls (experienced anesthesia and surgery but no mTBI), and mTBI animals (experienced anesthesia and controlled cortical impact). Two weeks after the sham-procedures or brain injuries, the rats were anesthetized, then transcardially perfused with phosphate buffer followed by 4% paraformaldehyde, and post-fixed fixed for 72 hours to preserve the brain tissue structure and antigenicity. For each group, the right visual cortex (ipsilateral to the mTBI) was sectioned at 30 Î_m. Sections were labeled with 0.2% anti-Iba1 (ionized calcium-binding adaptor molecule 1) to identify microglia. Sections were imaged using a Zeiss 710 confocal microscope. Image stacks (30 x 1 um) were saved as a two-dimensional maximum intensity projections (MIP) for analysis. Iba1+ profiles were analyzed using Fiji Image J and Microsoft Excel. We measured: cell number/density, soma area, the number of primary processes/cell, the distance between cell, each cells nearest neighbor distance, and the shape/perimeter/roundness of each soma. For the control, sham, and TBI rats; the morphological measures of average cell density, (396.12 Â± 11.77, 444.03 Â± 30.79, 425.65 Â± 17.36 positive cells/mm2), average soma area (39.67 Â± 1.81, 46.80 Â± 4.92, 46.21 Â± 2.70 Î_m2) and average number of primary processes (4.14 Â± 0.77, 4.27 Â± 0.65, 4.45 Â± 0.37) were similar between all groups for each measure. Likewise, the following distribution measurements for the control, sham, and TBI groups: average distance (111.87 Â± 2.69, 105.03 Â± 2.03, 108.91 Â± 1.88 Î_m), the average nearest neighbor distance (35.58 Â± 2.09, 32.11 Â± 1.77, 32.02 Â± 1.06 Î_m), the ratio of average distance between all cells to average nearest neighbor distance (4.47 Â± 0.42, 4.39 Â± 0.36, 4.68 Â± 0.18), and the roundness of each soma (0.65 Â± 0.01, 0.65 Â± 0.02, 0.64 Â± 0.02), were not distinct between the three groups. For each measure, control, sham, and TBI groups were compared using a Student's t-test. For each of the parameters tested herein there was no significant difference between Control vs. Sham, Sham vs. TBI, Control vs. TBI groups, t-test P>0.05). These findings suggest that aspects of the distribution, shape and size of the cell bodies of microglia are unaffected by a spatially and temporally distant mTBI. Additional work done in the lab has also analyzed the processes of these cells to see if mTBI had an effect on that aspect of their structure.

Mentor(s): Michael J. Friedlander (Fralin Biomedical Research Institute), Quentin S. Fischer, Susanna Kiss, Djanenkhodja Kalikulov, Fralin Biomedical Research Institute

CHRISTINE FAUNCE
VIRGINIA TECH /NEUROSCIENCE; CHEMISTRY

Single Nucleotide P129T Mutation Shows Susceptibility to Problematic Drug Use in Mice

A single nucleotide polymorphism (proline 129 to threonine) of the fatty acid amide hydrolase (FAAH) gene has been identified. This missense mutation has been associated with an increased susceptibility to problematic drug use in humans. However, it remains unclear whether the P129T mutation plays a causative, mechanistic role in maladaptive drug use behaviors. Using heterozygous P129T humanized knock-in mice on a C57Bl/6 background as breeding pairs, wildtype (WT) and P129T knock-in (KI) littermates were produced and used to evaluate the behavioral and biochemical changes that result from the P129T polymorphism. To evaluate behavioral effects of the P129T polymorphism, conditioned place preference (CPP) was used to assess reward-like behavior. Both WT and KI mice were given acute injections of saline or nicotine (0.1 â€“ 1.0 mg/kg, s.c.) in separate sides of the chamber for three sessions, and the final session (no injection) time spend in either chamber was quantified. To evaluate the biochemical effects of the P129T polymorphism, activity-based protein profiling (ABPP) was used to measure significant differences in active enzyme levels in WT and KI mice in whole brain as well as specific brain areas involved in drug reward and dependence. These results bring new knowledge to the field's understanding of this genetic mutation while utilizing both behavioral and molecular techniques. Further investigations to continue this research will evaluate the gene expression difference and behavioral profile of these genetically modified animals when administered different drugs. Additionally, further investigation of the mechanism by which this susceptibility is caused is of great interest.

Mentor(s): Matthew W. Buczynski (Virginia Tech, Neuroscience and Chemistry)

LEAH FORD
UNIVERSITY OF SOUTH CAROLINA/CHEMICAL ENGINEERING

Cultivation of Microalgae in an Osmotic Photo-Bioreactor for Wastewater Treatment and Agricultural Reuse

The tertiary treatment of wastewater entails the removal of ions from secondary effluent and prevents environmental hazards such as eutrophication and aquatic toxicity. Osmotic photo-bioreactors (OsPBR) are viable for tertiary treatment due to high forward osmosis (FO) membrane selectivity. Additionally, OsPBR's are advantageous, as they simultaneously cultivate algal biomass that can be harvested for biofuel. However, downstream treatment of diluted draw solute and accumulation of reversed draw solute in the wastewater limit the effectiveness of the OsPBR system. In this investigation, Chlorella Vulgaris and Scenedesmus Obliquus microalgae were integrated into a submerged OsPBR with 0.25 M diammonium phosphate, a common fertilizing agent, acting as the draw solute. Preliminary experiments revealed that the microalgae were able to uptake ammonium at an average rate of 7.35 mg/L-day, meeting the reversed ammonium flux under a hydraulic retention time (HRT) of approximately 10 days. It is hypothesized that at this HRT, the concentrations of ammonium and phosphate in the wastewater will remain stable, indicating efficient algal uptake of ions. Additionally, an OsPBR operated with algae is expected to have higher water flux from the wastewater than a control reactor without algae. Application of OsPBR's in the agriculture industry would lessen reversed solute accumulation due to microalgae uptake of ammonium and phosphate and would allow for reuse of the wastewater as fertilizer, eliminating the energy-intensive desalination process. This investigation demonstrated that OsPBR's are a sustainable wastewater treatment method that could effectively lower energy consumption and operation costs relative to conventional tertiary treatment processes.

Mentor(s): Zhen He (Virginia Tech, Civil and Environmental Engineering), Zixuan Wang, Virginia Tech, Civil and Environmental Engineering

SAMANTHA FRANKS
CONCORD UNIVERSITY/PRE-PROFESSIONAL BIOLOGY

Analysis of Connexin43 intracellular localization during cancer plasticity

Tumors are heterogeneous populations of partially differentiated cells that may arise from cancer stem cells (CSCs). CSCs are often innately resistant to traditional chemo- and radiotherapies. They can then enter an active state of self-renewal and differentiation through asymmetric division, recapitulating the heterogeneous tumor and leading to tumor recurrence. In addition, the progression of tumors toward metastasis has been attributed to a process named epithelial-mesenchymal transition (EMT) that generates CSCs while bestowing characteristics necessary for cell migration and invasion. Our previous research demonstrated a tumorigenic function for the gap junction protein connexin43 (Cx43) in glioblastoma CSCs through its interaction with microtubules. Cx43-mediated gap junctional intercellular communication is typically lost within primary tumors, which may be related to increased Cx43 intracellular localization observed following EMT. Thus, it is necessary to understand variations in Cx43 localization during cancer plasticity. Given the essential role for microtubules in trafficking of Cx43-loaded vesicles to the cell surface, the Cx43 tubulin binding domain has been assumed to be involved in Cx43 trafficking to the plasma membrane but also demonstrated as necessary for directional cell migration. Variations in Cx43 localization to microtubule-associated vesicles and microtubules were analyzed via three-color stochastic optical reconstruction microscopy (STORM). This technique allowed us to distinguish these very different Cx43 populations both intimately associated with the microtubule cytoskeleton during EMT and CSC differentiation. Therefore, this research will provide novel insights on the tumorigenic role of Cx43 in cancer plasticity through variations in subcellular localization.

Mentor(s): Dr. Samy Lamouille, Ph. D. (Fralin Biomedical Research Institute; Virginia Tech Carilion School of Medicine; Virginia Tech Department of Biological Sciences), James Smyth, Ph. D.; Fralin Biomedical Research Institute; Virginia Tech Carilion School of Medicine; Virginia Tech Department of Biological Sciences

ANDREW FUGARO
VIRGINIA TECH /ENGINEERING SCIENCE AND MECHANICS

Arrested Dynamics of Droplets Impacting Icy Surfaces

We study the competition between the fluid dynamics and freezing dynamics of droplets impacting icy surfaces. Experiments were conducted on two different frosted surface configurations: planar or suspended cable. The dynamics of droplet impact were captured using a side-view high-speed camera where the droplet was initially either room temperature or close to the freezing temperature. For droplets spreading on the planar substrate, the advancing contact line was arrested significantly faster as the surface temperature or initial droplet temperature were decreased. Droplets impacting the icy cable either detached and fell from the cable or were captured and frozen, depending upon the Weber number, surface temperature, droplet temperature, and the ratio of the droplet and tube diameters. A scaling model elucidated that the extent of droplet spreading is a balance between capillary-inertial effects and the specific cooling of the droplet toward its freezing temperature.

Mentor(s): Jonathan Boreyko (Virginia Tech, Mechanical Engineering), Farzad Ahmadi, Virginia Tech, Biomedical Engineering and Mechanics

JESSICA GANNON
VIRGINIA TECH /MECHANICAL ENGINEERING

Development of Histotripsy as a Non-Invasive Focused Ultrasound Ablation Method for the Treatment of Pancreatic Cancer

Pancreatic cancer is a fatal malignancy with a five-year survival rate of 7%, with most patients dying within six months. To address this need, histotripsy, a non-invasive and non-thermal focused ultrasound cancer ablation method, is being developed. Histotripsy uses high pressure (>15 MPa) ultrasound pulses to generate a cavitation â€œbubble cloudâ€ù that mechanically ablates the target tumor with millimeter precision and has been shown to be efficacious in treating liver cancers. In this study, we investigated the feasibility of histotripsy for the treatment of pancreatic cancer using two custom histotripsy systems designed and built for this study. These systems consisted of custom-built array transducers, driving electronics, and 3D motorized positioning systems for robotically-assisted treatments. First, using a 500kHz transducer, we investigated the feasibility of using histotripsy to treat excised canine and human pancreatic tumors, with the results showing a clear bubble cloud and generated ablation zones in the target. Next, we performed an in vivo experiment using a 1 MHz small animal transducer for the volumetric ablation of pancreatic tumors in a Pan02 subcutaneous mouse model. Results showed that we were able to successfully generate cavitation and achieve well-defined ablation zones within the murine pancreatic tumors. Tumor size decreased for every mouse that had been treated with histotripsy, with a 15% difference between treated-untreated tumor diameters one day post-treatment and 31% the following day. Overall, the results of this study suggest that histotripsy has the potential to become a novel non-invasive therapy method for the treatment of pancreatic tumors.

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

ANTHONY ABE OLIVER GEMINA
VIRGINIA TECH /MECHANICAL ENGINEERING

3D Reconstruction: Archiving High Quality 3D Models from 2D Images

To archive a history of tire wear during laboratory testing using a drum test equipment (rolling resistance machine), a methodology to reconstruct 3D view of the full tire using camera images has been developed. The rolling resistance rig allows control of camber and toe angles, normal load, velocity, and test surface. Several camera mounts were designed and installed on machine to capture tire wear during an accelerated wear experiment. This method is based on using 2D images, captured from different angles of a static tire, for developing a 3D cloud point model of the worn tire. We are trying to run 3D cloud point of the model and later have a surfacing mesh. Also, multi-step process was developed to enhance the quality of 3D models with selecting and cleaning the objects in images and adding more photos with additional cameras, as needed. Multiple software and programming libraries were evaluated for 3D cloud point and surfacing the mesh. In addition, Autodesk ReCap Photo was used to leverage the power of the cloud process and instantly create a 3D mesh model. Hypothetically, the goal of the project is to obtain a high-quality 3D reconstruction of the tire from images. Three-dimensional model can be used for understanding the effect of the experimental conditions better.

Mentor(s): Dr. Saied Taheri (Virginia Tech, Engineering)

MICHAEL GOLDSWORTHY
VIRGINIA TECH /COMPUTER SCIENCE

A Multi-Modal Data Set on Bat Habitats and Biosonar Behavior

Echolocating bats have sonar systems far superior to any human engineered sonar, especially while traversing dense foliage. A better understanding of bat biosonar could therefore aid in developing advanced sonar technologies. Bats are known to adapt their pulse bandwidths and durations according to their proximity to foliage. Bats are also presumed to navigate at least partially using acoustic landmarks. To aid in understanding these biosonar phenomenon, a multimodal dataset has been gathered. The modalities of the dataset include: point clouds of bat habitats (taken by laser scanner), bat flight trajectories (taken by an infrared camera array), localized soundwaves of bat sonar emissions (taken by a microphone array), and sonar echo recordings of the habitats (taken by a biomimetic sonar head). The pulses made though the flight were aligned with the trajectories and together placed in the foliage point cloud. A better understanding of biosonar adaptation may be discovered by analyzing this aligned dataset. In addition to observing the bats behavior from the exterior, measurements taken from the biomimetic sonar head give some sense of what the bats perceived with their sensory input. This data may aid in developing a theory of biosonar decision making based on the bats internal perception throughout their flights. Additionally, representations of the habitat geometry have been developed, a probability density function of the angles and distances from the laser scanned points relative to the bat's position and orientation, which may serve as inputs to machine learning algorithms to predict quantitative properties of bat biosonar behavior.

Mentor(s): Rolf Mueller (Virginia Tech, Mechanical Engineering)

BASIM GOTAH
CU BOULDER/PHYSICS

Biomimetic echomotion robot bats

Bats have been known to use echo phenomenon to sense objects, utilizing feedback from time-variant echo properties. The study investigates time-variant echo properties. A biomimetic sonar head with deformable emission and reception has been used to targets with simple geometries (sphere, cylinder, and cube) as well as random, more natural target geometries (artificial plants) from distances of about 1 meter. Time-variant echo signatures were found in all these cases, i.e., irrespective of target complexity and whether the time-variance was injected into the emission, the reception, or into both. This demonstrates that although the time-variant emission/reception characteristics had been previously measured only under careful conditions, they are capable of impacting real-world echoes. Even targets with distributed clouds of scattering facets did not obscure the effects of the changing conformation states. Hence these baffle deformations could serve the animals or man-made sonar systems that mimic them to encode additional echo information through time-variant echo signatures.

Mentor(s): Joseph Sutlive (Virginia Tech, Mechanical Engineering)

PRATEEK GOVINDARAJ
THE COLLEGE OF WILLIAM AND MARY/NEUROSCIENCE

Loss of CASK from Calretinin expressing cells leads to ataxia and cerebellar phenotypes

Cerebellar hypoplasia is a condition in which the cerebellum does not fully develop and often presents with ataxia. Previous studies have shown that the mutation, loss, or reduction of the X-linked gene CASK is associated with cerebellar hypoplasia in both human patients and murine models. CASK encodes a membrane-associated guanylate kinase protein with well-established roles in neural development and synaptic function. To test the role of CASK in cerebellar development, we used a floxed allele of CASK and deleted CASK from Calretinin expressing cells, which constitute a large population of neurons in the mouse cerebellum. (Caskfl/y::Calb2-Cre+/+). The resulting conditional mutants are viable but exhibit severe ataxia. Moreover, Caskfl/y::Calb2-Cre+/+ mutants perform significantly worse in a number of motor tasks, including accelerating rotarod trials. To understand the cellular mechanisms underlying these phenotypes, we quantified the morphology of the cerebellum in these mice. We found that both cerebellar layers and the total cerebellar area of the Caskfl/y::Calb2-Cre+/+ mice were significantly reduced compared with control mice. Additionally, the Caskfl/y::Calb2-Cre+/+ mice had smaller ratios of the molecular layers to the granular cell layers. We also assessed synaptic density and found that the Caskfl/y::Calb2-Cre+/+ mice had a lower density of synapses in the granular cell layer. These results begin to shed light on the cellular underpinnings of cerebellar hypoplasia in CASK mutants.

Mentor(s): Michael Fox (Center for Neurobiology Research, Fralin Biomedical Research Institute at Virginia Tech Carillion), Alica Kerr (Center for Neurobiology Research, Fralin Biomedical Research Institute at Virginia Tech Carillion)

ANDREW GUNSCH
COE COLLEGE/PHYSICS

Passive Attenuation to Allow Muon Calibration of NuLat Detector

The Neutrino Lattice Experiment (NuLat) is a novel neutrino detector made of 125 scintillating cubes. Due to its unique geometry, it is able to observe the topology of signals. Before data can be collected, the NuLat detector must be calibrated. One approach is calibration to muon signals, for the average energy deposited by muons in a plastic scintillator is well-documented. The detector was designed to collect positron and neutron capture signals from the Inverse Beta Decay of an anti-neutrino, so the higher-energy signals from muons would saturate the detector, clipping the signals and rendering the amplitudes unmeasurable. We built resistive pads to attenuate the signals from two of the detector's faces. These passive attenuators did not need to be symmetric, so they were assembled in the voltage divider configuration. The pads lowered the amplitude of the signals to a tenth of their initial levels. Then we used a Fortran algorithm to simulate muons propagating vertically through the detector. The simulated data was compared to the muons detected experimentally. The photomultiplier tube responses for similar events were comparable on the attenuated faces, but there was still saturation in the face that was not attenuated. Attenuating the signals shows promise for enabling muon calibration of NuLat. In the future, the detector will need two voltage ranges. There must be an attenuated range for measuring the signals from muons and a non-attenuated range for measuring the signals from the decay of anti-neutrinos.

Mentor(s): Dr. R. Bruce Vogelaar (Virginia Tech, Physics)

ELDRIDGE HAGER
VIRGINIA TECH /MICROBIOLOGY

Assessment of disinfection approaches for inactivation of antibiotic resistant strains of Enterococcus faecium and Pseudomonas aeruginosa in water intended for potable reuse

Antibiotic resistance has been identified by the World Health Organization as a global health threat. Infections caused by antibiotic resistant pathogens (ARPs) are significantly more difficult to treat than those caused by susceptible bacteria. Antibiotics and ARPs are excreted into raw sewage, creating the need to identify treatment technologies. The presence and possible proliferation of ARPs in reuse water distribution systems (RWDSs, systems that use treated wastewater for a secondary purpose) necessitates their removal by disinfection. Traditional disinfection of drinking water often relies on combinations of ultraviolet irradiation, ozonation, chlorination, and chloramination, but few studies have evaluated their relevancy in reuse water treatment. By quantifying the efficiencies of pathogen inactivation for each method and the extent ARPs are selected for, disinfection can be optimized during treatment with an emphasis on minimizing the spread of antibiotic resistance in RWDS and potential for human exposure. The opportunistic organisms studied represent antibiotic resistant and antibiotic susceptible strains of a gram-positive fecal pathogen, Enterococcus faecium, and a gram-negative environmental pathogen, Pseudomonas aeruginosa. All four strains were simultaneously inoculated in pasteurized drinking and reuse waters from two water reuse facilities (located in Virginia and Florida) and subsequently disinfected. Culturing of microbes at different time points following disinfection allows for analysis of microbial recovery and regrowth. Initial results of UV disinfection suggest that there is no difference in disinfection efficiency of E. faecium based on strain or water type. Poor acclimation of P. aeruginosa in test waters has demanded troubleshooting, and additional experiments are underway.

Mentor(s): Dr. Amy Pruden (Virginia Tech, Civil & Environmental Engineering), Haniyyah Majeed, Virginia Tech, Civil & Environmental Engineering and Ishi Keenum, Virginia Tech, Civil & Environmental Engineering

XAVIER HARRISON
VIRGINIA TECH /ART; CREATIVE TECHNOLOGIES

Laser scanning of bat habitats in Asia

Thanks to their sophisticated biosonar systems, many bats species are capable of navigating and pursuing their prey in dense vegetation. The echoes that are the basis for these sensorimotor capabilities depend on the geometry of the surrounding vegetation, the bats' flight trajectories, and the characteristics of their biosonar emissions. Ultimately, multi-modal data sets that cover all three aspects will be needed to understand how bat navigation is integrated into the animals' respective environment. In the current work, quantitative data on the vegetation geometry has been acquired using a laser scanning approach for about 15 sites distributed over northeastern China. At each site, a small representative plot of vegetation representing the habitat was selected and scanned with a mobile laser scanner that was positioned at 3 to 8 different locations to cover the vegetation samples. The laser scans were resulted in data sets for individual sites that contained between 28 million and 80 million points. In the next step of the work, it will be investigated how this data can be put into a form that makes the geometry of the vegetation readily accessible, e.g., through visual inspection or quantitative analysis. This could be done, for example, by generating surface meshes from the point clouds. In ongoing work, the trade-offs between computational effort, the need for manual intervention, and the utility of the resulting representations are being investigated.

Mentor(s): Rolf Mueller (Mechanical Engineering)

CAMERON HART
VIRGINIA TECH /BIOCHEMISTRY

Temperature and sugar feeding effects on Aedes aegypti mosquitoes' activity

Aedes aegypti mosquitoes, or the yellow fever mosquito, are most commonly known to spread diseases like dengue fever, chikungunya, zika fever, and yellow fever. This mosquito is easily recognized by the white markings on the legs. It originally came from Africa, however, it is now found all across the globe in tropical, subtropical, and temperate regions. Even though these mosquitoes are only trying to feed on blood for food, they are among the deadliest animals in the world. They are the cause of more than 700,000 deaths every year, and also account for almost 17% of the global burden of infectious diseases. With the increasing climate change epidemic that is sweeping the globe, there are many concerns as to how the mosquitoes will adapt and survive the change of humidity and temperature. In order to gather results on this topic, we used an actometer and a climatic chamber to measure mosquito activity at throughout a one week period at different temperatures and with different food sources. After this was tested, we measured the survival rate, and then ran a sugar analysis on the bodies of the mosquitoes to determine sucrose concentration post experiment. With the results we gathered, we can better understand how the Aedes aegypti mosquitoes will adapt and survive with the changing climate that is ravishing the earth today.

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

JARED HARVEY
VIRGINIA TECH /COMPUTER SCIENCE ENGINEERING

Towards Wrist Tremor Control Through an Exoskeleton

Millions of people around the world suffer from pathological tremors cause by illnesses such as Parkinson's and Essential Tremors. The patients commonly suffer from involuntary shaking of their extremities. These tremors affect not only the quality of life of the patients but also pose a potential risk to their well-being. This motivates researchers to seek out solutions in order to improve the patients' lives. One possible method of mitigating the tremors is through active robotic devices that reduce the severity of the tremors. The Tremor Alleviating Wrist Exoskeleton (TAWE) is an active robotic device developed for this purpose. It is a full wrist exoskeleton that decreases the tremors in the wrist through actuation from motors. The feasibility of the current design is examined by multibody modeling and dynamic analysis. The dynamic analysis considers human motion, wrist stiffness, and tremor dynamics. A major concern is whether a controller can be successfully designed for suppressing the coupled tremors at the wrist. It has been mathematically proven that, based on certain assumptions, TAWE can successfully suppress tremor and slightly augment muscle power, which is evaluated in preliminary simulation. More simulation validations and experiments are to be conducted as future work for performance measurement and improvement of this wrist exoskeleton design.

Mentor(s): Oumar Barry (Virginia Tech, Mechanical Engineering)

MADIGAN HAWKINS
UNIVERSITY OF IDAHO/PLANT SCIENCES: BIOTECHNOLOGY AND PLANT GENOMICS

A Tale of Two Cash Crops: Stewart's Wilt in Corn and Tobacco Mosaic Virus in Flue-Cured Tobacco

Pantoea stewartii subspecies stewartii is a proteobacterium vectored by the corn flea beetle that causes Stewart's wilt in corn plants (Zea mays), impacting sweet and popcorn production in the United States (US). A previous Tn-Seq study showed that the P. stewartii gene DSJ-22350 was essential for survival of P. stewartii in planta; however, its function remains unknown. 22350 is annotated as a member of the MarR family of transcription factors. MarR is associated with multiple antibiotic resistance in E. coli. To further understand the effect of this gene on P. stewartii colonization and virulence, in-frame deletion mutant and complement strains are being constructed to test for phenotypic changes through in planta assays. Understanding this gene may provide insights into possible disease intervention strategies and serve as a model for other phytopathogenic systems. Tobacco mosaic virus (TMV) is a highly studied RNA virus that reduces yield and quality of tobacco. TMV was previously thought to be seed-borne with virus on or in the seed coat (SC); however, recent studies have shown the virus to be seed-transmitted and capable of infecting endosperm (ED) and embryos (EM). Sixteen seeds from one TMV infected field grown K326 flue-cured tobacco pod were dissected into SC, ED, and EM. Real-time quantitative PCR (RT-qPCR) was used to determine viral concentration in each component. The highest concentration of virus was found in the SC, followed by ED and EM. This data supports recent findings that TMV is a seed-transmitted virus and may impact the seed production process.

Mentor(s): Ann Stevens (Department of Biological Sciences), Carol Wilkinson, Virginia Tech Southern Piedmont AREC, Department of Crop and Soil Sciences, wilki@vt.edu

LOGAN HEFLIN
UNIVERSITY OF IDAHO/BIOTECHNOLOGY AND GENOMICS

Exploring the importance of rain as a source of plant associated bacteria

Plant leaf-associated bacteria have been proposed to originate from soil, neighboring plants, and/or animals. Precipitation is another possible source of the plant leaf microbiome, but very limited research has been performed on the effect of rain on the microbiome of plant leaves. To investigate the effect of rain on the microbiome of the tomato leaves, a metagenomic analysis of rainwater, tomato leaves exposed to rain, and tomato leaves not exposed to rain was conducted. Rain and tomato plants were collected following rain events while sterile DI water and tomatoes kept indoors during rain events served as controls. 10g of tomato leaves were collected, mixed with 250 of sterile DI water and sonicated or massaged for 15 minutes An aliquot of the water and tomatoes samples was plated onto non-selective agar to measure microbial population density. In parallel, samples were concentrated by vacuum filtration and DNA was extracted. DNA was sequenced using the Oxford Nanopore Technologies MinION sequencing device. Sequences of similar species of microorganisms (Massilia putida, Massilia sp. B2, Massilia sp. WG5, and Pantoea agglomerans) were found to be present in the DNA extracted from rain samples and tomato samples that were exposed to rain but not in tomato samples that were not exposed to rain. Tomato leaves exposed to rain also yielded a higher microbial density than tomato leaves not exposed to rain; 175,963 and 83,333microbes/g respectively These results support the hypothesis that microbes in rain are so far neglected source of the plant leaf microbiome.

Mentor(s): Dr. Boris Vinatzer (Virginia Tech; Plant Pathology, Physiology, and Weed Science), Dr. Laura Strawn; Virginia Tech; Food Science and Technology

JORDAN HEIMAN
VIRGINIA TECH /CLINICAL NEUROSCIENCE

Identification of a novel appetite stimulant, transforming growth factor beta-3 (TGFÎ_-3)

The recently characterized protein transforming growth factor beta-3 (TGFÎ_-3) (25 kDa) is involved in adipose tissue energy metabolism but its effects on appetite regulation have not been investigated in any species. The purpose of this study was to evaluate the effects of intracerebroventricular (ICV; into the left lateral ventricle) injection of TGFÎ_-3 on hypothalamic physiology and feeding behavior in 7-day-old Japanese quail. Doses of 0.32 Î_g and 3.2 Î_g did not affect food intake, while a dose of 0.032 Î_g increased food intake for 120 minutes post-injection, relative to administration of the vehicle. Water intake was not affected. Birds injected with TGFÎ_-3 expressed less hypothalamic corticotropin-releasing factor mRNA than vehicle-injected individuals at 1-hour post-injection. The objective of the next experiment is to identify the hypothalamic nuclei that are activated in response to TGFÎ_-3 injection. This will be accomplished by detecting the expression of c-Fos, an indirect indicator of neuronal activation, in different sections of the hypothalamus. We are in the process of conducting a comprehensive behavior analysis to determine if any behaviors are altered in response to central TGFÎ_-3 injection. In conclusion, TGFÎ_-3 is a newly identified orexigenic factor in birds and future research will focus on elucidating the hypothalamic molecular mechanisms. Understanding a novel appetite stimulant could provide targets for developing strategies to treat eating disorders.

Mentor(s): Elizabeth Gilbert (Virginia Tech, APSC)

LUIS HERNANDEZ
VIRGINIA TECH /CIVIL AND ENVIRONMENTAL ENGINEERING

Blast Performance of Hybrid Internal FRP- and Steel- Reinforced Concrete Construction

Terrorist attacks and accidental industrial explosions have claimed the lives of countless citizens and affected the socio-economic wellbeing of communities around the world. Increasing the strength and reliability of our infrastructure can save many lives as well as greatly reduce the damage and economic losses sustained during explosions. This summer MAOP research project evaluated the use of hybrid steel-fiber reinforced polymer (FRP) reinforcement configurations to enhance the blast resistance of reinforced concrete construction. Compared with conventional steel rebar, FRP bars have superior ultimate strength at the expense of lower ductility. During blast events, energy dissipation is essential in reducing the damage that a structure obtains. Steel has excellent energy dissipation qualities because it undergoes permanent deformations and plastic behavior, while FRP has very high ultimate tensile strength but suffers from lower ductility and limited capacity to dissipate energy. Our research hypothesis is that the combination of both materials leverages the superior ultimate strength of FRP and the energy dissipation of steel reinforcement to provide superior blast performance than conventional reinforced concrete construction. These concepts were numerically evaluated by performing nonlinear single degree of freedom analysis on various configurations of hybrid steel-FRP reinforced concrete panels. The results of the analysis were used to design and construct test specimens to be subjected to large-scale blast testing using the Virginia Tech Shock Tube Testing Facility.

Mentor(s): Eric Jacques (Virginia Tech, CEE)

CECIL HICKAM

SURFACE COAL MINING IN CENTERAL APPALACHIA: IS BIOACCUMULATION OCCURRING IN THE HEADWATER STREAMS?

Surface coal mining in central Appalachia contributes to the contamination of headwater streams. Data from six headwater streams in central Appalachia has shown that in selenium rich streams, bioaccumulation occurred in salamanders and fish, with some being at the toxic level. These data will be used to determine if other trace elements (chromium, cobalt, nickel, copper, zinc, arsenic, strontium, cadmium) are at toxic levels in particular ecosystem media (i.e. particulate, primary consumer, predator, salamander, fish). The goal of the analysis is to determine if bioaccumulation is occurring by determining if there is a significant difference in the levels of elements among the media types. The methods include comparison by graphical analysis and a one-way analysis of variance. The results of these analyses will be presented in the poster.

Mentor(s): Dr. Daniel McLaughlin (Virginia Tech, Forest Resources & Environmental Conservation), Thomas Cianciolo, Virginia Teach, Forest Resources & Environmental Conservation

KATHLEEN HOHWEILER
TOWSON UNIVERSITY/GEOLOGY
BAILEY SNYDER
SINLIN BLACKWELL

The Doodle Dust Dilemma: Public Perception and Heavy Metal Detection at a Former Superfund Site

In 1989, the site of a former acid plant located near Peak Creek was designated as a Superfund site requiring remediation to protect public health. Despite EPA action, there still is evidence that heavy metals in the soil are leaching into Peak Creek. Because of the creek's Superfund status and its proximity to the surrounding town, we aimed to answer: does public perception relate to the measured amounts of heavy metals in Peak Creek? During the summer of 2019 we tested creek water, soil, and sediment at various sites to quantify heavy metal concentrations. We also deployed a short online survey via local community groups to town residents to gauge perception and use of the creek, and how these attitudes and behaviors may be impacted by knowledge of the Superfund site. There appears to be a disconnect between public perception of the creek and the actual heavy metals concentration in it. One percent of survey participants believed there to be no risk to public health, however, results indicate elevated levels of magnesium, calcium, lead, and iron in water samples from the remediated cap of the site as well as slightly further upstream. The goal of this project is to provide the town with the ability to locate and possibly remediate areas with high metals concentration. Information is being shared with the community through an ESRI StoryMap and extension-based infographics. This case study provides us with a look into the issues that remediated Superfund sites may cause, even after EPA action.

Mentor(s): W. Cully Hession, Leigh-Anne Krometis, and Brian Badgley (Virginia Tech, BSE and CSES/SPES), Submitted above

CHARLIE HOLGUIN
BELOIT COLLEGE/ECOLOGY, EVOLUTION, AND BEHAVIORAL BIOLOGY

The Effects of Silvicultural Treatments and Climate on Plethodon cinereus

Terrestrial salamanders (genus Plethodon) are lungless and a fully terrestrial species that depend on cool and moist environments to exchange gasses across their skin. With the removal of canopy trees, terrestrial salamanders can be exposed to conditions that can lead to warmer and drier microhabitats, which will then compromise their foraging abilities and opportunities. Using data collected from 1994-2018, we determined how climate and silviculture treatments affect reproductive condition in the red-back salamander (P. cinereus). We did not find a relationship between reproductive condition and silvicultural practices but we did find that larger body size and higher precipitation during the previous year led to larger clutch sizes and a greater proportion of gravid females in the following year. Our research suggests that even after timber harvest, salamanders are able to intake the required resources to reproduce at similar rates compared to the controls. However, future studies should look more closely at how this relationship might vary over time after canopy trees have been removed, and at the effects on recruitment of juveniles into the population, to compare with analyses conducted shortly after the removal of the trees.

Mentor(s): Dr. Haas (Virginia Tech, Department of Fish and Wildlife), Dr. Caruso , Virginia Tech, Department of Fish and Wildlife

ROSA HOUCHINS
VIRGINIA HIGHLANDS COMMUNITY COLLEGE/SCIENCE

1. Conservation of native bee habitats: integrating wildflowers into pastures
2. Tracking the Tobacco mosaic virus infection from infected tobacco seeds to seedlings by Quantitative Real-time PCR Analysis

This experiment was designed to incorporate wildflowers into pastures to provide a better habitat for native bees and combat their decline. We researched which flowering plants pollinators preferred and if these pastures attracted larger diverse population of bees. To find the abundance and diversity of bees present, we set out insect traps and conducted bi-weekly field observations. The results of the experiment show that adding wildflowers to pastures increase pollinator abundance and variety. Future work for this experiment includes monitoring grazing animals to find the effect of different plant species, for example, cattle health and production. The goal is to prove adding wildflowers and native grasses to pastures is a feasible solution to the native pollinator decline and economically benefits farmers. Tobacco mosaic virus (TMV) can impact the overall yield and quality of tobacco which will result in an economic loss for the grower. Historically, there has been controversy on whether to categorize TMV as a seedborne or seed-transmitted virus. The objective of this experiment is to track the movement of TMV from infected seeds to seedlings and demonstrate seed transmission. Seeds from a TMV infected cultivar `K 326` flue-cured tobacco plant were germinated for 14 days and dissected into roots, seed coats, and leaves. Total RNA was extracted from the three parts and synthesized into cDNA for analysis by quantitative real time PCR. TMV was present in all three parts with the highest virus concentration in the seed coat. Results demonstrate seed transmission of TMV in flue-cured tobacco.

Mentor(s): Megan O'Rourke (Virginia Polytechnic Institute, Department of Horticulture), Carol Wilkinson, Virginia Polytechnic Institute Southern Piedmont Agricultural Research and Extension Center, Crop and Soil Environmental Sciences, wilki@vt.edu

JULIA HUDACK
VIRGINIA TECH /BIOLOGICAL SCIENCES

Towards Detoxifying Poison Ivy Hairy Roots Using CRISPR Genome Editing

Much of the poison ivy genome is unexplored and very little is known about the production and significance of urushiol, the chemical produced by poison ivy that causes skin irritation in humans following contact. Furthermore, the ecological role of urushiol in the native environment is not well understood. The first proposed step in urushiol biosynthesis is the elongation of a C16 or C17 fatty acid forming an acyl tetraketide by a proposed type III PolyKetide Synthase (PKS) enzyme activity. The goal of this study was to identify which of four hypothesized PolyKetide Synthase (PKS) small gene families in poison ivy plants are necessary for urushiol biosynthesis. Genetic constructs containing CRISPR small guide RNA genes each designed to disrupt each of four phylogenetically distinct PKS small families were constructed using Golden Gate cloning. These four plasmids were transformed into Agrobacterium rhizogenes that were then prick inoculated on poison ivy seedlings to induce PKS-CRISPR genome edited mutant transgenic hairy root lines. Continuation of this study will utilize Real Time PCR to measure PKS gene expression and Gas Chromatography Mass Spectrophotometry to quantify urushiol levels in transgenic hairy roots edited by PKS-CRISPR constructs. PKS-CRISPR transgenic hairy root lines that show significantly reduced urushiol levels will identify PKS genes that are necessary for urushiol biosynthesis. Understanding which PKS gene is essential for the biosynthesis of urushiol will provide specific insights into the first step of urushiol biosynthesis, and enable focused studies on urushiol production in intact poison ivy plants from an ecological standpoint.

Mentor(s): Dr. John G. Jelesko (Virginia Tech, Plant Pathology, Physiology, and Weed Science)

ALANA HULL
VIRGINIA TECH /CLINICAL NEUROSCIENCE

Modulation of the default mode network using real-time fMRI

Functional magnetic resonance imaging (fMRI) relies on the coupling of blood flow in the brain and neuronal activity. This constantly changing hemodynamic response is turned into maps of whole-brain activity that are dependent on localized metabolic demands occurring at the time of data collection. Even when a subject is instructed to rest, distinct patterns of activity are nonetheless observed that can provide important insights into the healthy vs diseased brain. Many such â€œresting state networksâ€ù (RSNs) are defined, including the â€œdefault mode networkâ€ù (DMN) which is more prominent at wakeful rest and suppressed during various cognitive tasks. The DMN mainly involves the medial parietal, bilateral inferior parietal, and ventromedial frontal cortexes. A unique capability of this lab is the ability to track and analyze RSNs in real time. In this experiment, real-time fMRI scans with and without neurofeedback are used to determine if modulation of the DMN is a learnable skill. In addition, single session scans of healthy controls and subjects with various neurological and psychiatric disorders are compared to observe any baseline differences between the groups. Preliminary results indicate that healthy controls are initially more successful at modulating their DMN, which suggests DMN modulation as a possible diagnosis marker and/or therapy for these disorders. Longitudinal results from two healthy subjects suggest that DMN modulation does not improve with practice. Further longitudinal research is needed with additional subjects from all groups to confirm the results and identify other variables that may affect DMN performance.

Mentor(s): Stephen LaConte (Fralin Biomedical Research Institute at VTC, Human Neuroimaging Lab)

GRANT HUTCHINS
VIRGINIA TECH /AEROSPACE ENGINEERING
BEN PRITCHARD
VIRGINIA TECH /AEROSPACE ENGINEERING
BRYAN WELLS
VIRGINIA TECH /AEROSPACE ENGINEERING
JOSEPH CUNNINGHAM
VIRGINIA TECH /AEROSPACE ENGINEERING
PEDRO HENRIQUE DO NASCIMENTO
VIRGINIA TECH /COMPUTER ENGINEERING
JAKE LURIE
VIRGINIA TECH /AEROSPACE ENGINEERING

SPACEDRONES: An Autonomous Multi-Agent Space System Testbed (AMASST) Utilizing Quadrotors to Simulate CubeSat Proximity and Rendezvous Operations

Autonomously controlled micro-satellite networks will be crucial to future space operations. To facilitate the development of such systems requires a testbed capable of verifying control system and algorithm robustness in a near-realistic simulation. Previous testbeds, such as air bearing tables, only have three Degrees of Freedom (DOF). Utilizing drones as test vehicles adds a fourth DOF, increasing simulation realism. Our testbed uses autonomous micro-drones tracked by motion capture cameras to model the relative motion of two bodies in orbit using the Hill-Clohessy-Wiltshire equations. Additionally, users can execute maneuvers via thrust input functions, which will allow for path planning through trajectory optimization. Throughout the project, we increased durability and improved optical tracking of the drones. The development of this four DOF testbed is a crucial step towards a six DOF satellite-to-drone simulation environment.

Mentor(s): Dr. Jonathan Black (Virginia Tech, Aerospace Engineering), Dr. Kevin Schroeder (VT, Aerospace Engineering) and Dr. Daniel Doyle (VT, Aerospace Engineering)

JENNA ISRAEL
CORNELL UNIVERSITY/ENVIRONMENTAL ENGINEERING

Comparing quality of wastewater treatment plant biosolids with respect to antibiotic resistance genes in the United States and India

Land application of treated sewage sludge, or biosolids, is an attractive way to keep waste out of the landfill while adding nutrients to soil. However, the practice has potential to distribute antibiotic resistance genes (ARGs) to pathogens exposed to solids or agricultural products grown in biosolids via horizontal gene transfer. Overuse of antibiotics has been shown to enhance antibiotic resistance and the two countries studied have contrasting practices: in India, last-resort antibiotics are available without a prescription, while United States antibiotics regulations are more stringent. This study seeks to compare the ARG profile of land-applied biosolids from wastewater treatment plants (WWTPs) in India and the United States. Influent and final solids were sampled from an urban India WWTP in Summer 2019. DNA was extracted using a FastDNAâ„¢ Spin Kit for Soil and analyzed using quantitative Polymerase Chain Reaction for the 16S rRNA, intI1, and sul1 genes. These values were compared with previously gathered data from a WWTP in rural Virginia. A two-sided Wilcox signed-rank test was performed on target gene abundance normalized to 16S rRNA between each plant's influent and final solids. It was predicted that normalized gene abundances in the influent and solids will differ significantly between plants. Solids at the US plant were predicted to contain fewer antibiotic resistance genes. The land application of biosolids in India, whether for agricultural purposes or landfilling, requires further risk assessment to determine if land application puts the public at greater risk of antibiotic resistant infections than conventional solids disposal methods.

Mentor(s): Dr. Amy Pruden (Virginia Tech, Civil and Environmental Engineering), Abraham Cullom: Virginia Tech, Civil and Environmental Engineering Ayella Maile-Moskowitz: Virginia Tech, Civil and Environmental Engineering

KAVYA IYER
ROANOKE COLLEGE/BIOCHEMISTRY

Regulation of Amino Acid Transport by p53 in Glioblastoma Multiforme

Glioblastoma mutiforme (GBM) is an aggressive form of brain cancer with a dismal prognosis. The Sontheimer laboratory has previously demonstrated that System xc- (SXC), an L-cystine/glutamate antiporter, is largely responsible for tumor-associated epilepsy, invasion, and poor patient survival. The tumor suppressor p53 gene (TP53) is commonly mutated in cancer and was recently tied to regulating glutamate biology. Ongoing studies demonstrate gliomas with wild-type TP53 have lower SXC compared to mutant TP53 gliomas. These mutant TP53 cells consequently express more p53 protein. The small molecule PRIMA-1MET, which can functionally restore mutant p53, is consequently of interest for these studies. Therefore, we hypothesize gliomas with high SXC expression and mutant TP53 are more migratory in vitro and this SXC-mediated migration can be corrected with PRIMA-1MET. Furthermore, we utilized the Xena UCSC and Gliovis online platforms to investigate the relationship between SXC levels and TP53 in the GBM patient population. To test our migration hypothesis, we used a Transwell Migration Assay with JX14 (wild-type TP53), JX12 (TP53-/-), JX22 (mutant TP53), and JX22 with two concentrations of PRIMA-1MET. Confocal imaging of the Transwell filters revealed that the JX22 cells were the most migratory and JX22 cells treated with 3Î_M PRIMA-1MET showed migration similar to JX14 cells with wild-type TP53. Correlation graphs from the Gliovis database also show a positive correlation between SXC and TP53 expression. Future studies aim to repeat these promising Transwell Migration results and test the effects of PRIMA-1MET in an in vivo xenograft glioma model.

Mentor(s): Dr. Sontheimer (Fralin Biomedical Research Institute, Neuroscience)

ALEXIS JACKSON
VIRGINIA TECH /BIOLOGICAL SCIENCES

Wetlands in a warming world: The importance of wetlands in headwater carbon cycling

Wetlands are important places for biogeochemical carbon cycling and are among the most productive ecosystems. However, their contributions of both CO2 and CH4 have often been overlooked, and consequently, the role of wetlands in carbon emissions remains largely unknown . As temperatures increase, wetlands can shrink or dry completely which may change the magnitude of CO2 and CH4 emissions from these areas .We placed sensors in wetlands at Coweeta Hydrological Laboratory, NC and in Jefferson National Forest, VA to monitor how 4 wetlands contract and expand over the summer. To measure the amount of CH4 and CO2 that each wetland emits to the atmosphere, we used a flux chamber attached to a portable greenhouse gas analyzer. Flux data from Coweeta wetlands suggest that they are sources for both CO2 and CH4. However, the data from wetlands near Poverty Creek suggested that they could be sources of CO2 but sinks for CH4. To test how microbial uptake of dissolved organic carbon (and subsequent CO2 and CH4 production) may change with increasing temperature, we set up bioassays to incubate wetland water samples at ambient and +3 Â°C-increased temperature with half containing an added carbon source. We predict that temperature increases CH4 and CO2 production. This experiment will provide insight into the current and future role of wetlands in carbon cycling within headwater stream networks.

Mentor(s): Dr. Erin Hotchkiss (Virginia Tech, Biological Science)

ALEXANDER JEAN-FRANCOIS
WESLEY COLLEGE/BIOLOGY

Exploring Fitness Awareness Mobile Applications with Former Athletes

Physical inactivity is a major public health concern around the world. It is the fourth leading risk factor for global mortality, contributing to 6% of deaths globally and approximately 3.2 million deaths each year. It is associated with increased risk of obesity, diabetes, cardiovascular disease, hypertension, some types of cancers, and other disabling conditions. Reduced physical activity and corresponding weight gain and other health issues is notably common in former athletes, as their physical activity decreases after they stop competing, but they do not adjust their food consumption or identify alternative exercise plans. This research is rooted in the FitEx physical activity intervention program that leverages group dynamics to encourage healthy behaviors, and in the FitAware mobile application platform that facilitates increased awareness of individual and team fitness goals and behaviors. The goals of the study are to explore the impacts of the newest version of FitAware in an abbreviated FitEx session, comparing the performance, reactions, and change in behaviors of former athletes and non-athletes. The study examined use of the FitAware mobile application as part of a 3-week FitEx-style physical activity program. 12 people took part in the program, divided into 3 groups: 1 that included former athletes and 2 that included non-athletes. Study results suggest that this type of intervention correlates with increased use among former athletes compared to non-athletes. Fitness programs like FitEx and mobile applications like FitAware seem to be a good match for former athletes due to their competitive nature.

Mentor(s): Dr. Scott McCrickard (Virginia Tech, Computer Science), Andrey Esakia, Virginia Tech, Computer Science

JENNY JOHNSON
HOLLINS UNIVERSITY/BIOLOGY

Structural changes to intercellular junctions during adenoviral infection influence viral spread.

Adenoviruses cause a range of pathologies including mild respiratory illnesses, conjunctivitis, gastroenteritis, and myocarditis. The cell-cell adhesion protein coxsackie-adenovirus receptor (CAR) is a cellular receptor for adenovirus serotype 5 (Ad5) and is primarily localized at tight junctions that mechanically couple cells together. Work completed by the Smyth laboratory demonstrates targeting of gap junction proteins transcriptionally by Ad5, interestingly gap junctions are maintained and stabilized at cell-cell borders. A described interplay between cellular junctional structures and the dynamic microtubule network plays a critical role in maintenance and remodeling. We hypothesize through virally-induced intercellular junction stabilization, upregulation of viral receptor CAR on uninfected cell surfaces occurs to predispose them to infection. To test this, we performed super resolution localization microscopy to measure microtubule interactions with intercellular junctions between infected cells and uninfected naÃ¯ve neighbor (NN) cells. A multiplicity of infection of 0.01 was used to infect confluent monolayers of HaCaT cells prior to fixation 24 hours later and immunolabeling. Infected cells were identified using an antibody against Ad5 while microtubule plus-ends were identified with an antibody against EB1 and cell-cell borders identified with wheat germ agglutinin. Microtubule density was quantitated to determine differences between uninfected-uninfected, infected-NN, and infected-infected cells. While alterations in cytoskeletal/cell junction interaction imply junctional remodeling, studies are investigating localization and expression of CAR, and predisposition of NN cells to infection. In addition to providing insight into regulatory hubs governing cell junction formation this work will contribute to identification of novel antiviral targets aimed at limiting viral spread during disease.

Mentor(s): James Smyth (Virginia Tech MolVis)

KAYLA JONES
NORTH CAROLINA A&T STATE UNIVERSITY/ANIMAL SCIENCE

The Result of Nerve Growth Factor Beta Improving Embryonic Cleavage Rates

Nerve growth factor, (NGF) beta (Î_) is a seminal plasma protein that has been associated with sire conception rates in cattle. Previous research showed that administration of NGFÎ_, via culture media to cows, resulted in improved conceptus development. Though this finding was thought to be an indirect effect of improved corpus luteum (CL) function, questions raised if NGFÎ_ could act directly on the embryo to promote development. This work seeks to determine the effect of NGFÎ_ supplementation during in-vitro fertilization (IVF) on cleavage and blastocyst rates. How does the administration of NGFÎ_ in culture media affect cleavage and blastocyst rates during in-vitro fertilization? Abattoir-derived bovine ovaries were used for recovery of cumulus-oocyte complexes (COC). Selected COC were placed in maturation medium. Expanded COC were inseminated with frozen-thawed spermatozoa, and IVF media was supplemented with either 0 ng/mL or 100 ng/mL of NGF Î_. Presumptive zygotes were transferred to development medium in a tri-gas chamber with 5% CO2, 5% O2, and 90% N2 in a humidified atmosphere at 39Â°C, mimicking the bovine uterine climate, until 8 days. Treatment with NGFÎ_ increased the percentage of cleaved embryos at 48 hours and the percentage of hatched embryos at 8 days per oocyte. Treatment of NGFÎ_ did not alter the percentage of blastocysts per cleaved embryo or the percentage of hatched blastocysts. These results show that the NGFÎ_ can act directly on the embryo during fertilization to alter embryonic development, specifically embryonic cleavage rates. Seminal plasma NGFÎ_ could potentially play a role in improving fertility in cattle. Future in-vivo studies should assess the downstream effects of NGFÎ_ treatment on conception rates in cattle.

Mentor(s): Jamie Stewart (Virginia Tech, Large Animal Clinical Sciences), Jacob Stewart, Virginia Tech, Animal Poultry Sciences

MARIAMA KABORE
VIRGINIA TECH /MICROBIOLOGY

LdtR, a master transcriptional gene regulator, modulates motility in Sinorhizobum meliloti

Ldtr is a transcriptional master gene regulator that modulates motility, among other phenotypes, in the agriculturally significant bacterium Sinorhizobum meliloti. It was previously shown that an ldtr deletion strain (_ldtr) exhibits reduced cell length and decreased osmotic stress tolerance. Additionally, we have found severe defects in swimming motility in _ldtr. Remarkably, _ldtr suppressor mutants arise on swim plates and exhibit about 80% motility restoration. It remains to be shown how LdtR influences flagellar motility. Motility gene regulation in S. meliloti occurs in a hierarchal manner, where the flagellar filament is produced last. To identify the mechanism of motility regulation by LdtR, the amount of flagellar filament protein was compared for wild type, _ldtr, and two suppressor mutants using western blot analyses. These assays demonstrated that the _ldtr strain and both suppressor mutants produce Flagellin, the filament protein necessary for flagellar motility, comparable to wildtype. Contrary to published data for a different S. meliloti strain, quantitative osmotic stress assays on solid agar plates in the presence of 0.6M sucrose showed that the deletion strain grows to levels similar of wildtype. In future experiments, alternative means to measure osmotic stress in liquid cultures will be utilized. Lastly, whole-genome sequencing will identify the mutations that restore motility of the ldtr deletion strain in two suppressor mutants. These results will allow us to locate where LdtR fits in the motility regulation hierarchy and how it establishes influence upon motility.

Mentor(s): Dr. Birgit Scharf (Biology), Richard Sobe, graduate student Virginia Tech, Molecular Biology

GRANT KAWECKI
VIRGINIA TECH /BIOCHEMISTRY

Insight into Islet Amyloid Polypeptide (IAPP) and Amyloid-Î_ Peptide Interactions Using Molecular Dynamics Simulations

Amyloid-beta (AÎ_) and islet amyloid polypeptide (IAPP) are small peptides, classified as amyloids, that have the potential to self-assemble and form cytotoxic species, such as small soluble oligomers and large insoluble fibrils. The formation of AÎ_ aggregates facilitates the progression of Alzheimer's disease (AD), while IAPP aggregates induce pancreatic Î_-cell apoptosis, leading to exacerbation of type 2 diabetes (T2D). Cross-amyloid interactions between AÎ_ and IAPP have been described both in vivo and in vitro, implying the role of AÎ_ or IAPP as modulators of cytotoxic self-aggregation of each species, and suggesting that AÎ_-IAPP interactions are a potential molecular link between AD and T2D. Using molecular dynamics simulations, â€œhot spotâ€ù regions of the two peptides were studied to understand the formation of hexamers in a heterogenous and homogenous peptide-containing environment. Systems of only AÎ_(16-22) peptides formed antiparallel, Î_-barrel-like structures, while systems of only IAPP(20-29) peptides formed stacked, parallel beta sheets and had relatively unstable aggregation structures after 2 Î_s of simulation time. Systems containing both AÎ_ and IAPP (1:1 ratio) hexamers showed antiparallel, Î_-barrel-like structures, with an interdigitated arrangement of AÎ_(16-22) and IAPP(20-29). Eccentricity based oligomer shapes for the heterogeneous systems were very similar to those of the homogenous AÎ_(16-22) systems after RMSD convergence. According to the amyloid pore theory, this increase in Î_-barrel formation could lead to increased cytotoxicity of IAPP aggregates in a mixed system. Ultimately, this work seeks to provide atomistic insight into both the mechanism behind cross-amyloid interactions and structural morphologies of these toxic amyloid species.

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

KENDALL KELLEY
UNIVERSITY OF GEORGIA/MECHANICAL ENGINEERING

Residential HVAC System Performance Comparison Using Cloud Computing

Contractors are facing increasing pressure to provide energy-efficient systems at an affordable cost to meet emerging housing needs. Commissioning is a critical part of a buildings lifecycle where builders and users verify system performance, i.e. energy consumption. Current energy monitoring technologies ineffectively communicate data, reducing stakeholders ability to optimize energy systems. Residential energy management systems fall short of leveraging the maximum benefit of modern cloud based data analytics tools. Using the case study method, this study measures the energy performance of Heating, Ventilating, and Air Conditioning (HVAC) systems in real time through the use of smart sensors installed in affordable housing units in Virginia. One-stage, two-stage, and variable speed HVAC systems were installed throughout a community of identical townhomes for field testing of energy performance. Two smart sensors were installed to allow for real time remote data collection and system control. Amazon Web Services, a cloud computing platform, was used to remotely perform the analysis from any location connected to the internet. Preliminary findings of this work in progress show that, when users are in control, two-stage units are more energy efficient. The variable speed units only outperform other units when residents allow for the smart thermostat to control the HVAC system autonomously. Furthermore, the use of cloud computing has shown to be more cost effective, and powerful than standard commissioning processes which are limited due to data accessibility and personal computing hardware limitations. The findings and methods developed from this study transfer to multiple uses in the transdisciplinary effort to develop Intelligent Infrastructure for Human Centered Communities.

Mentor(s): Dr. Frederick Paige (Virginia Tech, Department of Civil and Environmental Engineering)

SOONYOUNG KIM
VIRGINIA TECH /PSYCHOLOGY

Deep Selection: Inferring Employee Traits from Resume Style Using Neural Networks

We explored the predictability of individual factors related to job performance (e.g., cognitive ability and Big Fiver personality traits) based on applicant's resume formatting that was inferred by a computer. Humans typically emphasize the content of the resume, such as education, work experience, and skills listed, when subjectively evaluating the applicant. Because job applicants may falsify or exaggerate their resume information to match the prospective employer's desires, using the content to draw inferences about the applicant has limitations. To address this limitation, we trained an artificial neural network to learn the common visual features within a resume. We used these the visual features as predictors in a machine learning to predict an applicant's work-related traits on a sample of 435 resumes. We found that the visual features of a resume could predict both people's personality traits and their cognitive ability beyond chance levels. We compared those predictions with the ratings made by two human raters using a linear regression model that predicted the true trait scores with the human rater scores and the neural network model's predictions. Results show that neural networks significantly improved the explanatory ability of the model compared to only using human ratings. The relationship between resume style and people's traits could not be explained by simple measures of visual appearances such as the word count or darkness of content. Using this scalable, practitioners can extract additional information from their existing selection process to better identify qualified job candidates within large pools of applicants.

Mentor(s): Ivan Hernandez (Virginia Tech, Psychology)

JIWOO KIM
VIRGINIA TECH /BIOCHEMISTRY

Analyzing Receptor Abundance in Sinorhizobium meliloti

Sinorhizobium meliloti is a nitrogen-fixing soil bacterium that uses chemoreceptor proteins to detect plant chemical signals and to navigate its environment. In the study of S. meliloti chemoreceptor stoichiometry, it was observed that the McpU abundance increases when epitope tags (between 1 and 2.8 kDa in weight) are added to the carboxy-terminal end. We hypothesize that the epitope tags that are several amino acids in size are physically blocking the protease recognition site that is at the C-terminal end. The goal of this project is to find the mechanism that increases the McpU abundance by investigating if alteration or deletion of the putative proteolysis sites has the same effect as adding the epitope tags. The McpU abundance in mutants was compared to the McpU abundance of the wild type S. meliloti using immunoblotting. The protease recognition site location was narrowed down to the last 25 amino acid residues because the deletion of the last nine and 25 amino acids showed a significant increase in McpU abundance. Deletion of the last 39 amino acids showed a slight McpU increase. Alteration of the first putative proteolysis site showed a decrease in McpU. This study is important for projects that study alphaproteobacteria's protein stoichiometry because using epitope tags for detection and quantification could be a potential pitfall. Effect of increased McpU abundance on other chemoreceptors' abundance can be further studied.

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

TRENT KITE
VIRGINIA TECH /MICROBIOLOGY

Structural and Functional Characterization of the Putative Peptidoglycan Binding Domain Protein LysMD3

Fungal allergens have been implicated as major exacerbating factors in those who suffer from Asthma, Allergies, and chronic inflammatory states of the respiratory tract. These pathological states arise from increased immune stimulation characterized by increased Th2 cytokines, leading to a hypersensitive response. How the mammalian immune system recognizes generalized fungal allergens is of extreme importance; as it can elucidate the signaling pathways that govern this inappropriate inflammatory response of the respiratory tract. LysMD3 is a novel protein with proposed chitin and peptidoglycan binding activity. The LysMD3 protein was electroporated into E.coli cells, harvested mid-log phase, sonicated and purified by FPLC using 6x-polyhistidine tag cloned into the pet32A vector. Purity was assessed via 12% SDS-PAGE electrophoresis. The Histidine tag was removed from LysMD3 via TEV protease cleavage and subsequently processed via Gel-Filtration. LysMD3 underwent differential scanning fluorimetry in order to ascertain appropriate folding and provide a putative melting point. Analytical gel filtration allowed us to determine whether the protein's native state was in a monomer,dimer, trimer, etc conformation. Circular Dichroism spectroscopy was performed to elucidate the secondary structure of the LysMD3. Finally Isothermal calorimetry was done to provide insight into the binding affinity, stoichiometry, heat of formation, and entropy of the LysmD3 interaction with its proposed ligand Chitin. This information will provide a basis on which more experimental evaluation can be done to elucidate the role of LysMD3 in the immune response of humans with allergic inflammation and further lead to our understanding of novel targets for therapeutic intervention.

Mentor(s): Christopher Lawrence (Virginia Tech, Biological Sciences), Shiv Kale, Virginia Tech, Biological Sciences

NATHAN LAM
VIRGINIA TECH /COMPUTER SCIENCE

Functionality in 3D printed low-cost upper-extremity prosthetics

Living with the need of a prosthetic brings many challenges in operating through everyday life for those with upper-extremity loss. Although there are prosthetics that offer functionality and performance similar to an actual arm and hand, most people cannot afford these types of artificial limbs. 3D printing is an increasingly viable option for creating low-cost prosthetics. Especially in children, this type of prosthetic is a prime option due to growth out of the prostheses, requiring new ones to be bought regularly. A crucial aspect of designing any prosthetic is integrating functionality. Some methods used to make a prosthetic functional include bionics, myoelectric sensors, and tendon stringing. The current study aims to find ways to make 3D printed prosthetics functional and useful by incorporating mechanisms that improve movement within the prosthetics. In the current study, tendon stringing was utilized. Participant involvement allowed for a fitted design incorporating a functional elbow joint and fingers where strings attached to each finger, were run along the forearm, and then tied to the elbow. With this, when the elbow bends, the strings are pulled causing the fingers to grip. The goal is to also integrate a personalized interface where a mold of the arm will be positioned inside the prosthetic for a more customized fit. In 3D printing prosthetics, the possibilities are limited. Where it might be difficult to include components such as bionics and myoelectric sensors, there are methods that can be used to make these prosthetics affordable and functional for everyday use.

Mentor(s): Dr. Blake Johnson (Virginia Tech, Industrial and Systems Engineering), Yuxin Tong, Virginia Tech, Industrial and Systems Engineering

ERIN LE
VIRGINIA TECH /HUMAN NUTRITION FOODS AND EXERCISE

Understanding the Role of Single Nucleotide Variants on NHLH2 in mRNA levels

Prader-Willi Syndrome (PWS) is a complex genetic disorder that causes life-threatening obesity in children. Characteristics of PWS include insatiable hunger, weak muscles (hypotonia) at birth, intellectual disability, small hands and feet, and an inability to produce reproductive hormones (hypogonadism). PWS is caused by the deletion of the paternally-expressed chromosome region between 15q11-q13, with the smallest common deleted region containing the non-coding RNA SNORD116. This type of non-coding RNA works by interacting with other RNAs to regulate their expression, translation, or splicing. There are over 665 million known single nucleotide variants (SNVs) in the human genome, but little understanding of how individual SNVs might disrupt these RNA:RNA interactions. Our laboratory is currently investigating an RNA interaction between SNORD116 and NHLH2 that may lead to NHLH2 reduction shown by Burnett and colleagues. An in silico analysis has shown that 7 SNVs are found in the 3'UTR of NHLH2 that could possibly disrupt the predicted interaction between SNORD116-3:NHLH2. One of these disruptions results in a 4.45125 kcal/mol decreased delta G energy between SNORD116-3 and NHLH2. Preliminary results show success in the creation of one Nhlh2 SNV by in vitro site-directed mutagenesis. Using Neuro 2A cells, we will perform an in vivo analysis with the mutant Nhlh2 mRNA Snord116 interactions, and comparing to normal/wild-type Nhlh2, analyze Nhlh2 expression levels. These studies will help provide insight to understanding the interaction between NHLH2 and SNORD116 as well as give the scientific community a better understanding of molecular interactions that may cause obesity and disrupt energy balance in PWS.

Mentor(s): Deborah Good (Virginia Tech, Human Nutrition Foods and Exercise), Matthew A. Kocher, Virginia Tech, Department of Human Nutrition Foods and Exercise

CLAIRE LEE
VIRGINIA COMMONWEALTH UNIVERSITY/CHEMISTRY/BIOLOGY

Evaluating mechanisms underlying lymphocyte mimicry in metastatic breast cancer

Breast cancer is one of the leading causes of cancer mortality for women worldwide, one in eight women are at risk for it in their lifetimes. Most breast cancer deaths are caused by metastasized cancer impairing vital organ function. One of the ways cancer cells can obtain metastatic properties is through lymphocyte mimicry, the inappropriate expression of lymphocytic genes. Specifically, the aberrant expression of chemokine receptors by cancer cells allows for inappropriate responses to immune signals, migration, and increased ability to survive in circulation. Our laboratory recently identified a novel transcriptional complex composed of the Ikaros Zinc Finger transcription factor, Aiolos, and STAT3 that regulates gene expression in immune cells, including that of chemokine receptors. Interestingly, they have been independently linked to multiple cancers, including metastatic breast cancer. Therefore, we hypothesized that Aiolos and STAT3 may cooperate to induce chemokine receptor expression in metastatic breast cancer cells. Here, we find that Aiolos expression STAT3 activation are increased in metastatic breast cancer cells (MDA-MB-231) as compared to non-tumorigenic (MCF-10A) and non-metastatic (HCC-70) controls. This correlated with increased expression of the chemokine receptor CXCR4, which has been previously linked to metastatic cancer, at both the transcript and protein level. Importantly, shRNA knockdown of Aiolos in metastatic cells resulted in decreased surface expression of CXCR4. Collectively, these data support a role for Aiolos, possibly in collaboration with STAT3, in the induction of a metastatic gene signature in human breast cancer, and provide insight into potential targets for reducing metastatic breast cancer.

Mentor(s): Kenneth Oestreich (Virginia Tech, Immunology)

OWEN LEITZEL
VIRGINIA TECH /COMPUTATIONAL AND SYSTEMS NEUROSCIENCE

Impaired Blood Brain Barrier and Loss of Glutamate Transport in Atypical Astrocytes are Associated With Post-Traumatic Epileptogenesis

It is estimated that 50 million people worldwide have epilepsy. Epilepsy is a disease characterized by spontaneous, recurrent seizures (SRS) that affects people regardless of age or gender causing early disability and death. Traumatic brain injury (TBI) is the most common cause of acquired epilepsy. Despite the known traumatic event and period of latency to seizures, predicting when PTE will develop is impractical and seizure prevention remains the main challenge. Astrocytes are important for maintaining homeostasis in the central nervous system (CNS). They aid in blood brain barrier (BBB) integrity and glutamate uptake. Both processes are affected by TBI and may contribute to epileptogenesis. In our recent work, we demonstrated that astrocytes can become atypical as little as 30 minutes post-injury and are associated with the development of SRS. These atypical astrocytes are characterized by downregulation of many proteins including glutamate transporter 1 (Glt1). Leakage across the BBB is also common in mice that experience TBIs and can be observed with cadaverine when it is taken up by surrounding neurons at the site of BBB damage. We hence hypothesized that failure of astrocytes to reuptake glutamate coincides with BBB damage after TBI and is more severe in animals with post-traumatic SRS. To test this, we induced repeated diffuse TBI (rdTBI) in male C57Bl/6 mice using our weight drop model. Continuous electroencephalography (EEG) was then utilized to stratify animals with and without SRS. Lastly, we used cadaverine leakage as a readout for BBB damage and Gtl1 downregulation for atypical astrocytes. Our results demonstrate greater loss of Glt1 by cortical and hippocampal astrocytes as well as greater hippocampal BBB damage in animals with post-traumatic SRS.

Mentor(s): Oleksii Shandra (Virginia Tech, Neuroscience)

LYDIA LOAN

STATE UNIVERSITY OF NEW YORK COLLEGE OF ENVIRONMENTAL SCIENCE AND FORESTRY/ ENVIRONMENTAL RESOURCES ENGINEERING

Monitoring Macroinvertebrate Community Behavior Along a Flow Gradient in Sinking Creek, VA

Benthic macroinvertebrates have very distinct behavioral patterns and are often used as indicators of water quality. However, little is known about their resistant and resilient behavior, such as burrowing and drift, in the face of drought events. Observing this behavior could potentially be useful for better monitoring water quality and providing insight on community interactions. The objective of this research is to monitor the behavior of various benthic macroinvertebrates in the face of disturbance. Sinking Creek, a tributary of the New River in Giles County, VA, varies in flow over the summer months. We observed drought and storm events and took regular flow data, as well as benthic samples and drift samples. We predict that there will be different resilient taxa present in the drift samples as well as resistant taxa in the benthic samples, and this will be affected by flow.

Mentor(s): Dr. Bryan Brown (Virginia Tech, Biological Sciences), Sara Cathey, Virginia Tech, Biological Sciences

NICOLE LOPEZ-VEGA
UNIVERSITY OF PUERTO RICO, RIO PIEDRAS CAMPUS/BIOLOGY

Role of the PH and FYVE domains of the autophagic protein Phafin2

Autophagy is a catabolic process that is highly conserved in eukaryotes. During autophagy, a portion of the cytosol, which contains invading pathogens and long-lived proteins, is taken up by an autophagosome. This double-membrane organelle fuses with lysosomes, where the autophagosome's contents get recycled into amino acids and metabolite degradation products. Autophagy dysfunction leads to pathological consequences and impacts a wide range of human disorders, including chronic inflammatory diseases. Phafin2 is a lysosomal protein involved in the induction of autophagy. To do so, Phafin2 associates to lysosomes through membrane phosphatidylinositol 3-phosphate (PtdIns3P). Phafin2 is composed by an N-terminal PH (Pleckstrin Homology) domain followed by a central FYVE (Fab 1, YOTB, Vac 1, and EEA 1) domain. The purpose of this study is to establish the role of the PH and FYVE domains in PtdIns3P binding. Previous reports suggest that both domains contact PtdIns3P. To further investigate these interactions, we isolated recombinants Phafin2 as well as its PH and FYVE domains. The proteins were purified using affinity chromatography and gel filtration and their quality evaluated using SDS-PAGE. SDS-PAGE results showed that all proteins were purified to homogeneity. Our biophysical data suggest that the FYVE domain of Phafin2 is the sole responsible domain for PtdIns3P association. We are currently performing additional studies using liposomes to confirm that the PH domain does not interact with the lipid.

Mentor(s): Daniel G. S. Capelluto (Virginia Tech, Biology)

PIPER MACNICOL
VIRGINIA TECH /CHEMISTRY

Elucidating the Effect of Polymer Molecular Weight on Metal Chelation

Approximately 130 million metric tons of rare earth elements (REEs) were mined in 2015, and the need for REEs will continue to increase. REEs are crucial components in electronics, solar energy, batteries in hybrid vehicles, and catalysts. Thus, the need for an efficient and environmentally safe technique to extract and refine REEs is an emerging issue. One viable technique, which we are investigating, is the use of polymers that contain metal-chelating ligands. We modified linear polyethyleneimine with aminomethyl phosphonate chelating groups and strategically varied the molecular weight to synthesize a series of poly(ethyleneimine methylphosphonate) (PEI-MP) polymers. This series of materials enabled us to elucidate the effect of molecular weight on chelation. Isothermal titration calorimetry (ITC) was used to study the thermodynamics of the binding of the REEs to each linear PEI-MP. ITC directly measures binding affinity (Ka), enthalpy changes (Î”H), the stoichiometry of the interactions. Thus, changes in Gibbs free energy (Î”G) and the entropy (Î”S) can be calculated. Preliminary data indicates that as the molecular weight of the PEI-MP increases, the repeat units per metal ion bound increases as well. We also found that the stoichiometry of the interactions is dependent on molecular weight.

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

SID MADHAVAN
VIRGINIA TECH /CLINICAL NEUROSCIENCE

Identification of Key Sequences in Human Tau Protein for Aggregation in Alzheimer Disease and Related Tauopathies

Alzheimer Disease (AD) is the sixth leading cause of death in the United States, and leaves characteristic trademarks in the brain, one being neurofibrillary tangles (NFTs). NFTs form as tau proteins are hyperphosphorylated and become insoluble, ultimately creating highly ordered aggregates that lesion brain cells. Failures in clinical trials on other AD-related proteins make tau a major target for AD drug discovery. In the human brain, tau has six alternatively spliced isoforms, containing 0, 1, or 2 N-terminal inserts, and 3 or 4 C-terminal repeat regions, referred as 0N3R, 1N3R, 2N3R, 0N4R, 1N4R, and 2N4R. Currently, how tau isoforms aggregate and induce neurotoxicity is largely unknown. Using the largest isoform 2N4R as a template, we engineered, expressed, purified, and systematically characterized three series of truncation mutants using recombinant technology, biochemical, and biophysical techniques. These series included 8 N-terminal truncation mutants, 5 C-terminal truncation mutants, and 3 C-terminal truncation mutants with attached peptide sequences. Detailed aggregation analysis of the truncation mutants revealed the critical role of the second and third repeat regions (R2 and R3) in tau aggregation. Deletion of both R2 and R3 repeat regions prevents protein aggregation. Interestingly, truncation mutants regained aggregation competency when a hexapeptide sequence from either R2 or R3 was added, but not if a shorter tripeptide sequence was added.

Mentor(s): Dr. Bin Xu (Virginia Tech, Biochemistry)

WILLIAM MARTIN
VIRGINIA TECH /ENVIRONMENTAL RESOURCES MANAGEMENT

Influence of Predation and Habitat Complexity on the Functional Stability of Stream Insect Communities

Communities of organisms are dynamic. This change through time is due to intrinsic factors as well as extrinsic factors. These factors coexist and are interactive. The sum of the effect of these factors is greater than each individual factor. These factors determine which organisms are present and their respective abundances. Biodiversity has become a buzzword in modern conversations. However, does high biodiversity among species actually correspond to the functioning of an ecosystem? Perhaps it matters more what organisms do (function) rather than which species they are (classification). In this analysis, we look at how the influence of predation and habitat complexity affect the functional stability of stream insect communities. Functional diversity gives a good indication of how well and ecosystem will function. Generally, when ecosystems are functioning properly, nutrients are cycled and energy flows throughout the environment.

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

FRANK MAZZOLA
VIRGINIA TECH /CIVIL ENGINEERING

Impact of High Chloride Levels in Galvanized Iron Infrastructures and Possible Corrosion Control Strategy in Washington Suburban Sanitary Commission (WSSC)

The WSSC's service area is periodically subjected to high chloride levels in its water, possibly due to road salt contamination from runoff. The goals of the study were to investigate the corrosion potential of galvanized iron pipes (GIP) when in contact with higher chloride water and to examine whether higher doses of orthophosphate corrosion inhibitor can counter higher corrosivity from higher chloride. A GIP was harvested from WSSC and cut into 2-cm long sections, with the pipe's exterior coated with epoxy, and mounted in 125-mL glass jars. Jars were completely filled with water from four conditions: two with ~40 ppm chloride and two with ~490 ppm, with normal orthophosphate (0.3 mg/L as P) and a range of higher orthophosphate doses. Jars were continuously agitated on a shaker table; their water replaced every 2-3 days. Samples were collected every 2 weeks for metal analysis on an ICP-MS and turbidity measurements were taken weekly. Preliminary results indicated that 13 times higher chloride in water increased iron concentration by a factor of ~6 and discoloration from turbidity increased by a factor of ~10. But the corrosivity of higher chloride water, as measured by turbidity and iron release, could be reduced by 50% by dosing 11.3 mg/L phosphate instead of 3.9 mg/L. The corrosion rate measured by oxygen consumption also decreased by 74% at the higher levels of phosphate. The results proved that higher chloride increased corrosivity of water to GIPs, the effects of which could be partly ameliorated by higher doses of orthophosphate.

Mentor(s): Dr. Marc Edwards (Virginia Tech, Civil & Environmental Engineering), Hisyam Mohsin, Jeffrey Parks; Virginia Tech, Civil & Environmental Engineering

ARACELY MENDOZA
WASHINGTON STATE UNIVERSITY/ANTHROPOLOGY

Are Traditions Salient To How U.S. Latinx Members Interact With Their Communities

In this study I aimed to understand how traditions found within the U.S. Latinx communities were being changed or forgotten through the generations. In order to evaluate this, I conducted ethnographic interviews with 10 individuals who identified as being a part of the Latinx/Chicanx/Hispanic community, hoping to find out how much they were aware of their own traditions and whether they planned to continue practicing them. In order to do this, I constructed a list of initial questions asking about their parents' upbringing, stereotypes, activities, their generation (e.g., first or second gen), and nationality identity. Through the first round of questions I came to the realization that some of the interviewees were not sure of what â€œtraditionsâ€ù entailed and that traditions may not necessarily be a salient part of their membership of the Latinx community. I also found that the order and way in which I asked questions affected responses. In collaboration with Drs. Aaron Ansell and Anne Pisor, I was able to come up with a shorter, more comprehensive list of questions. I also let the interviewees take more control of the interview. Through this I learned how class and race play a role in how people identify with their Latinx heritage. Going forward, we will use the results and common themes we found in the interviews to inform a second round of interviews and a survey about how likely participants are to engage within their communities and whether these themes are factors in their daily interactions.

Mentor(s): Anne Pisor (Washington State University, Anthropology), Aaron Ansell, Virginia Tech, Religion and Culture

ANVITHA METPALLY
VIRGINIA TECH /CLINICAL NEUROSCIENCE

Examining the psychological mechanisms underlying obesity: the importance of eating and exercise motivations and attitudes

Obesity is a multifaceted issue that is derived from a combination of genetic and behavioral factors, and is difficult to reverse over time. In order to combat obesity and help obese individuals lose and maintain weight loss, the psychological factors that support how and why individuals engage in healthy lifestyle choices such as eating a balanced diet and engaging in regular physical activity, must be understood. To date, few studies have investigated the relationship between psychological factors such as eating and exercise attitudes and motivations in obese populations. Behavioral economic measures, self-reported questionnaires, and neuropsychological assessments were utilized to understand why obesity is linked to poor lifestyle choices. From data gathered through Amazon mTURK, a cross-sectional analysis of the relationship between lifestyle choices, and attitudes towards and motivation for these choices was conducted in a large sample (n=450) of metabolically stable adults (ages 18-45) with a range of BMIs. In comparison to obese individuals, non-obese individuals make more health conscious decisions and demonstrate greater motivations for and more positive attitudes towards eating and exercise. Regression models were used to determine the capacity of these health behaviors, motivations, and attitudes to predict obesity. Our findings indicate that eating and exercise motivations and attitudes may be the psychological mechanisms underlying the unhealthy lifestyle choices that contribute to obesity. The results from this study will lay the groundwork for interventional studies to target altering the motivations and attitudes of individuals towards the ultimate goal of sustained weight loss in obese populations.

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

ASHLEY MICKENS
MIAMI UNIVERSITY/ENVIRONMENTAL EARTH SCIENCE

Predicting methane emissions in a eutrophic reservoir using an iterative near-term forecasting model

Freshwater reservoirs emit large quantities of greenhouse gases (GHGs) to the atmosphere relative to their small surface area globally. Among GHGs, Methane (CH4) is a potent greenhouse gas and has 34Ã– the radiative forcing of carbon dioxide. Reservoirs are currently estimated to emit between 3-52 tetragrams of CH4 per year, but it is still unclear how much CH4 is emitted from reservoirs relative to other anthropogenic sources. CH4 ebullition (i.e. bubbling of CH4 gas from freshwater sediments), particularly, is a large emission pathway of CH4 from reservoir surfaces. However, models that attempt to predict CH4 ebullition rates from reservoirs is lacking. During summer 2019, we measured ebullition rates weekly, and created an iterative forecasting model that predicted ebullition rates in a eutrophic drinking water reservoir in southwest Virginia, USA. We integrated data from a forecasting model that predicts water temperature seven days in advance, and input those temperatures into an auto-regressive ebullition model to predict ebullition rates the following week. Our observed value of CH4 provided the starting point for the forecast and was updated weekly. We performed a linear regression of the mean of the observed ebullition rates to the forecasted ebullition rates and found that our weekly forecasted rates were well correlated with the observed ebullition rates. This forecasting model serves as a novel approach to predicting CH4 ebullition rates from freshwater reservoirs.

Mentor(s): Cayelan Carey (Virginia Tech, Biology)

ANDREW MILLER
VIRGINIA TECH /SYSTEMS BIOLOGY

Sphingosine Kinase Inhabitor Discovery Through De Novo Chemical

Lymphatic cancer is associated with changes in cellular signaling pathways. The inhibition two sphingosine kinase isoforms, SphK1 and SphK2, is believed to help diminish these lymphatic cancers. SphK isoform inhibitors are currently found through manual in silico methods of molecular modeling, docking, and analysis. Traditional methods of inhibitor discovery use small numbers of inhibitors tested and analyzed by a researcher for viability. To improve discovery times, machine learning could be used. A deep neural network (dNN) trained to predict effective inhibitors would be able to isolate important features of each potential inhibitor. This would lead to faster, more efficient discovery of SphK inhibitors. The large dataset required in dNN training could be created using the protein enumeration feature of Schrodinger's PathFinder tool. Through this, many more potential inhibitors would be available to train the dNN, similar to a genetic algorithm. PathFinder's enumeration process has been shown to be more effective at representing and testing the entire chemical space. This allows an unbiased dNN to be created and inhibitors to be found faster and at a smaller computational cost than before. It is hypothesized that the combination of protein enumeration and dNN training will produce viable SphK inhibitors faster and more efficiently than traditional methods. A weighted product was used to determine the effectiveness of known inhibitors and their individual amino acids and showed that patterns exist for a dNN to learn from. According to recent reports, a de novo method of chemical ideation is 22% more effective over traditional methods.

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

BRIANNA MIRANDA
VIRGINIA TECH /GEOSCIENCES

Evaluating marine records of polar environmental change during a past global warming event

Our planet is currently undergoing major climatic and environmental changes making it imperative to know how it will continue to evolve into the future. We can leverage the geologic record of similar past events in order to understand the full scope of environmental feedbacks and make predictions for how the Earth responds to these events. During the Early Jurassic Period (millions years ago) there were episodes of global warming caused by volcanic activity that resulted in large-scale deoxygenation, acidification, and mass extinctions in the oceans. This research explores one of these events that occured approximately 183 million years ago at two different locations, Walakpa and South Barrow, in the Arctic on the North Slope of Alaska. In order to determine the changes that occurred in the carbon cycle, samples from each locality are analyzed for their carbon isotopes using mass spectrometry. Samples were also analyzed for their organic carbon, iron, and pyrite sulfur contents to understand whether the water column was oxygenated or not at the time of deposition. Across both localities we see a negative shift in carbon isotopes that may reflect the increased atmospheric carbon dioxide sourced from volcanic activity. Iron data suggest deoxygenated (i.e. anoxic) water columns developed across this time period at both localities. Walakpa records a shift to higher pyrite burial whereas South Barrow maintains consistent burial of pyrite. Shifts in rates of pyrite burial may be reflecting local changes in anoxia. Our data records clear shifts in carbon isotopes and marine water column oxygenation associated with atmospheric warming due to volcanically sourced carbon dioxide. Because we see deoxygenation associated with high carbon dioxide in our Jurassic records, this suggests we may expect increased marine deoxygenation in the oceans in the future.

Mentor(s): Ben Gill (Virginia Tech, Geosciences)

JONATHON MONROE
VIRGINIA TECH /BIOLOGICAL SCIENCES

Microbial Metabolic Fingerprints of Tributary Streams

Global climate change increases variability in weather, resulting in changes to surface water connectivity in stream networks. These variations cause rapidly changing interactions between aquatic and terrestrial ecosystems that result in microbially-mediated organic carbon breakdown and greenhouse gas production. The role of microbes in carbon cycle responses to changing climate and hydrology is still poorly quantified. To better predict the effects of climate change, changes in microbial metabolic diversity over space and time must be linked with environmental variability. We analyzed microbial functional diversity through a community-level physiological profiling (CLPP) method using Biolog EcoPlates, which contain 31 different carbon-substrates in triplicate per plate. We added surface water and benthic samples from twelve sites along tributary streams of the Jefferson National Forest and Coweeta Hydrologic Laboratory to individual EcoPlates, where color changes directly relate to metabolism. Microbial metabolic diversity and metabolic rates were significantly different among spatially isolated sample sites (e.g., intermittent discontinuities versus permanent surface water). Preliminary results suggest a strong positive correlation between microbial metabolic diversity and community-level carbon-substrate metabolism (RÂ_=0.70). Ongoing sampling will determine how temporal differences in metabolic diversity occur with varying flow levels and seasonal changes. Measuring changes in the functional diversity of microbial carbon metabolism will inform further consequences of environmental changes on carbon cycling and freshwater ecosystem function.

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

MARC MORALES
LYCOMING COLLEGE/NEUROSCIENCE

Inhibition of PI3K/P110Î_ overcomes Temozolomide resistance in Glioblastoma

Glioblastoma (GBM) is the most prevalent and malignant primary brain tumor with 45% of all occurring brain tumors being GBM. Patients presenting with GBM have poor prognosis with a low median survival time even after extensive treatment, such as surgical removal of the bulk tumor, ionizing radiation, and chemotherapy with temozolomide (TMZ), rendering GBM a difficult disease to treat. The phosphoinositide 3-kinase (PI3K) pathway has been shown to be an essential factor for cell survival in GBM cells. Specifically, the p110 catalytic subunit is characterized as a biomarker for GBM recurrence and tumor aggression. Additionally, p110 has been found to provide GBM cells with the ability to resist TMZ. For this reason, this study is set to determine how p110 contributes to TMZ resistance in GBM cells. We hypothesize that a combination of p110 inhibitors and TMZ will synergistically reduce the viability of the GBM cells compared to each single treatment. To test this hypothesis, different GBM cell lines were treated with TMZ and/or p110 inhibitors at different doses and cell viability was determined using the MTS assay. It was found that combinational treatments of p110 inhibitors such as TGX-221, GSK-2636771, AZD-8186, and AZD-6482 with TMZ resulted in a drastic reduction of GBM cell viability, whereas p110 inhibitors or TMZ alone failed to do so. These findings suggest a clinical relevance in which combinational treatments of p110 inhibitor and TMZ may be more effective than conventional therapeutics in an effort to increase the median survival time for GBM patients.

Mentor(s): Zhi Sheng (Virginia Tech, Cancer Biology)

ADA MORRAL
VIRGINIA TECH /PHYSICS

Nonlinear Processes in Artificially Designed Nano-Structures

Nonlinear optical processes such as second harmonic generation (SHG) and photon up-conversion have a large variety of applications in the fields of material science, nano-photonics, biology, and medicine. More specifically these optical processes can be used for light-triggered drug therapy, high-resolution bio-imaging, solar energy harvesting, and security. In both processes, a material emits photons at a smaller wavelength compared to the excitation wavelengths. The emitted photons have a higher energy compared to the excitation photons and in both cases the infrared spectrum of light can be converted to a visible spectrum. In this study, a novel artificial material was explored for its potential to demonstrate both SHG and photon up-conversion. The samples were fabricated with an optical adhesive, stamped into a specific pattern. The sample was integrated into an advanced optical emission set-up where it could interact with wavelengths in the range of 980 nm. A high resolution spectrometer in the set-up collected the sample's emitted photons. Based on the collected emissions it was clear that SHG occurred and evidence pointed toward the occurrence of photon up-conversion as well.

Mentor(s): Dr. Giti Khodaparast (Virginia Tech, Physics)

CHRISTINA MOUNZER
VIRGINIA TECH /HUMAN NUTRITION, FOODS, AND EXERCISE

Using Organoids to Investigate the Role of NIK in Colorectal Cancer

Colorectal cancer is the third most common cancer diagnosis in the United States and is characterized chronic inflammation in the colon. The canonical NF-ïÅ«B pathway is well studied and attributed to chronic inflammation in cells, while the noncanonical NF-ïÅ«B pathway is understudied in the context of colorectal cancer. Our goal is to characterize the role of the noncanonical pathway in colorectal cancer. Preliminary data suggests that dysregulation of the noncanonical pathway results in significantly increased tumorigenesis in the colon. The purpose of the noncanonical pathway is to elicit an immunological response, in which the NF-ïÅ«B inducing kinase (NIK) is central to regulating this pathway. To better understand the role of NIK, we generated colonic organoids from stem cells of NIK-knockout and wild-type mice for comparison. This provides an in vitro understanding of whether NIK has protective qualities and its effect on epithelial cell composition in the colon. Based on preliminary data, we observe differences in the stem cell distribution of NIK versus wild-type villi, as well as size differences. This leads us to consider a possible explanation for the discrepancies. We suspect that the NIK organoids are smaller because of mutated epithelial cells and may be smaller because of missing cell populations. Through this study, we hope to better understand the role of the NF-ïÅ«B signaling pathway in the disease pathogenesis of colorectal cancer. These results can be harnessed to better develop treatments and provide insight into which cell types are most susceptible for early detection.

Mentor(s): Dr. Irving Coy Allen (Virginia Tech & Virginia-Maryland College of Veterinary Sciences-- Department of Biomedical Sciences and Pathobiology)

AUSTIN MURRAY
VIRGINIA TECH /BIOCHEMISTRY

A Putative Amphipathic Î±-Helical Motif in Brome Mosaic Virus Potentially Sufficient for Targeting the Perinuclear Endoplasmic Reticulum

Brome mosaic virus (BMV) is a well-studied positive-strand RNA [(+)RNA] virus that belongs to the alphavirus-like superfamily comprised of important plant, animal and human pathogens. BMV encodes for replication proteins 1a (BMV 1a) and 2apol as well as movement and coat proteins. BMV replicates inside viral replication complexes (VRCs) that are localized at endoplasmic reticulum (ER) membranes, which are remodeled by BMV 1a to form VRCs. Two previously-identified amphipathic Î±-helices within BMV 1a, dubbed Helix A and B, were thought to be responsible for â€œanchoringâ€ù BMV 1a to ER membranes. Several plasmid constructs were made to express various mCherry-tagged BMV 1a fragments that contained Helix A and/or B to determine if either of the two helices are sufficient to target the perinuclear ER. Fluorescence microscopy visualization showed various dominant localization patterns of different BMV 1a fragments. Intriguingly, any of the BMV 1a fragments containing Helix B consistently displayed localization patterns akin to wild-type BMV 1a. This suggests that Helix B is sufficient to target proteins, be it BMV 1a or mCherry, to ER membranes. Future studies will determine whether Helix B is sufficient to target other proteins to ER membranes, what amino acid(s) in Helix B is critical in ER targeting, and the possible effect of overexpression of the aforementioned fragments on interfering with the ER membrane association of BMV 1a and BMV replication. The long-term objective is to determine if overexpression of Helix B and/or its derivatives is a novel method to control viral replication.

Mentor(s): Xiaofeng Wang (Virginia Tech, PPWS)

AARON NAPIER

Land Use as a Factor in Nutrient Loading in Karst Streams

The Valley and Ridge physiographic province of Virginia is characterized by bands of limestone valleys and sandstone ridges nestled between the highlands of the Blue Ridge Mountains and the horizontal rock strata of the Appalachian Plateau. The valleys formed as a result of the Cambrian aged limestone being more easily soluble than the quartz-rich ridges. This landscape, characterized by caves and sinkholes, is known as karst and act as conduits transmitting groundwater. Due to the relatively gentle slopes and soil characteristics, much of this area is prime farmland, which is the suspect of nutrient loading in cave streams. This was studied by analyzing nitrates in 7 cave streams all located in Southwest Virginia and Northeast Tennessee. In order to determine if land use affects nitrate levels in karst streams, GIS was utilized to determine the percentage of pastured, forested, and urban land that lies within a 1km radius of sample locations. Nitrate levels were found to be significantly higher in karst streams that have higher percentage area of hay/ pasture land use and lower percentage of forested land use.

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

WALTER NEWSOME
THOMAS NELSON COMMUNITY COLLEGE/COMPUTER ENGINEERING

A biomimetic sonarhead for surveying bat habitats in Asia

Echolocating bats can navigate through dense foliage while using acoustic landmarks for localization. To do so, they rely primarily on their biosonar systems which are vastly superior to man-made sonars. To better understand these capabilities, echo data has been gathered in bat habitats with a biomimetic sonarhead. For this work, we have improved upon an existing biomimetic sonarhead. These improvements include a stereo camera system that can be used to create point-cloud representations of the environment, a screen to display live echo data, a GPS module to track location, and spherical markers to track the sonarhead in space with an external camera array. The voltage amplification board of the sonarhead has also been redesigned for efficiency. The sonar head emits ultrasonic pulses through a transducer that is later received by two microphones mounted in bat-shaped ears. It is well known that certain bat species often move their ears creating a Doppler effect, for this reason, the silicon made ears move every time the microphone sends a signal. The integrated stereo camera captures images that can help us approximate object distance surrounding the device. These improvements will help us better understand how bats use biosonar and give insight on how to replicate this system. Our sonar head was successfully tested in several bat habitats across northeastern China. With the collected echo data, we plan to find correlations between bat behavior and acoustic perception by using our device in combination with a microphone and camera array to monitor real bat dynamics.

Mentor(s): Dr. Rolf Mueller (Virginia Tech, Mechanical Engineering)

NHAT QUANG NGUYEN
SUNY ESF/BIOTECHNOLOGY

Cytocompatibility of Novel Tripeptide Hydrogel for Use in Biomedical Applications

Hydrogels are widely being studied across multiple fields from food and personal care products to medical devices and drug delivery systems. There are many different types of hydrogel, however not all of them are biocompatible in the human body because of toxicity and stability limitations. In this research project, a peptide-based hydrogel composed of a tripeptide, was fabricated by dissolving the peptide in deionized water and inducing peptide self-assembly into a dense network of long fibrils. The samples were stored in 70% ethanol to sterilize. The hydrogels were tested for cytotoxicity as well as its sterilization stability. Hydrogel samples of varying concentration were sterilized either at 25 ï‚°C or 37 ï‚°C and then exposed to NIH 3T3 murine fibroblasts. Fibroblasts were chosen due to their wide use in cytotoxicity screening as well as the potential connective tissue use for these hydrogels. Once the sterilization protocol was established, a full cytotoxicity study was performed for 24 hr with a range in tripeptide concentrations. The results revealed the hydrogels were unstable at elevated temperatures during sterilization but some concentrations remained stable at 25 ï‚°C. Cytotoxicity studies suggest the dissolved tripeptide and fibril hydrogels were cytocompatible with the fibroblastic cells. Future work will focus on how to stabilize the hydrogels at body temperature and their potential use for biomedical applications.

Mentor(s): Abby Whittington (Chemical engineering and materials science and engineering)

KAAVYA NIMMAKAYALA
VIRGINIA TECH /MATERIALS SCIENCE AND ENGINEERING

De-icing through two novel chemical and mechanical techniques

Substrates with specialized surface properties can serve to minimize the adhesion strength of ice and to enable robust deicing with minimal applied force. Historically, de-icing employed either mechanical scraping, or chemicals that are either toxic or environmentally detrimental. Low interfacial toughness coatings, a passive de-icing technique, proved that a sheet of ice can detach after introducing a single crack, but was shown successful only for deposited water, not frost. An active energy input technique used for buckling ice off surfaces demonstrated a bent beam can mechanically detach ice off surfaces; however, the concept lacked modeling and was tested only for uniform ice sheets, not droplets or frost. We investigate these two methods: the low interfacial toughness coating's application to frosted surfaces, and the buckling of ice droplets off substrates while varying droplet size and surface wettability. To test the low interfacial toughness coating, an aluminum surface with a polydimethylsiloxane rubber coating with a large surface area was thermally bonded to a cold plate. The frost grew thick enough so its self-weight would cause it slip, and the system was tested in two temperature conditions: room temperature and -12Â°C in a walk-in freezer. In the same freezer, the buckling of ice droplets was tested on aluminum substrates in a linear translation stage setup. High speed imaging captured the detachment of the ice droplets, and simple scaling analysis showed the required bending moment to detach the ice droplets from the surface as a function of droplet size and surface wettability.

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

SHAHD NURI
VIRGINIA TECH /HNFE

Exercise and its Effects on Blood Flow in mdx mice

Duchenne's Muscular Dystrophy (DMD) is an X-linked degenerative muscle disease for which there is no cure. DMD is caused by a mutation in the gene encoding dystrophin, a protein that stabilizes the muscle membrane. Lack of exercise and overeating are universal problems in our society. Consequently, chronic diseases such as obesity, hypertension, and Type II diabetes pose an even higher threat to boys with DMD because of their minimal physical activity and the high-fat foods they consume. Dystrophin is also absent from the smooth muscle of vascular walls, so blood flow in DMD boys is compromised. However, it is possible that exercise could be beneficial. Mdx mice are a model of DMD. We tested the hypothesis that exercised mdx mice (mdx-Run) would exhibit increased blood flow compared to sedentary mdx mice (mdx-Control). Blood flow was measured with a Full-field Laser Perfusion Imager (FLPI). After baseline FLPI assessments, mice were split into mdx-Run (n=6) and sedentary mdx-Control (n=6) groups. After exercise on a running wheel for 4 weeks (mdx-Run) or cage activity only (mdx-Control), a final FLPI assessment was determined for both groups. One week later, all mice were euthanized, and Tibialis Anterior (TA) and hearts collected. Tissues were serial sectioned and stained with either Masson's Trichrome to assess fibrosis, or with anti-Von Willebrand Factor (VWF) to detect potential sites of vascular injuries. Our preliminary analyses suggest there was no difference in blood flow in exercised vs. sedentary mdx mice.

Mentor(s): Dr. Robert Grange (Virginia Tech, HNFE)

CARRIE OREY
VIRGINIA TECH /BIOLOGICAL SCIENCES

Using Hypoxia to Induce Neuronal Phenotypes in the N29/2 Cell Line

Oxygen is critical for metabolic processes in all living organisms, and neuronal cell lines are no exception. Neuronal cells are commonly cultured in an atmospheric oxygen concentration of approximately 21%; However neuronal tissues and organs, such as the brain, normally have a reduced oxygen concentration, ranging from 0.5% - 8%. Recent studies have shown that an atmospheric concentration of 10% oxygen is more efficient for studying the generation of peptide hormones in endocrine cells, but the effect of hypoxia on phenotype and gene expression within different neuronal cell lines remains unclear. This study seeks to determine if cell morphology, viability, and RNA expression levels are improved under a hypoxic environment. The hypothalamic neuronal cell line, N29/2, was grown under hypoxia (10% O2) and normoxia (21% O2) conditions for 24 and 48 hour time points. Cells under each condition were compared using Trypan Blue viability, by visually examining the neuronal phenotypes, and using qPCR for quantitative RNA analysis of neuron-specific genes. Preliminary results suggest that N29/2 cell viability in a hypoxic environment does not vary significantly from a normoxic atmosphere after 24 hours ($t(2) = -1.22$, $p > 0.05$) or 48 hours ($t(2) = 1.87$, $p > 0.05$). Gene expression results are pending. If hypoxia enhances neuronal morphology, viability, and gene expression, future results will propose a more appropriate model for the study of neuronal control in obesity and metabolic research.

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

HARVEEN PANTLEAY
VIRGINIA TECH /PSYCHOLOGY

Help-seeking attitudes moderate the relationship between stress and psychological quality of life in college students

Stress is often characteristic of the â€œcollege experienceâ€ù and can affect the overall quality of life, specifically psychological health. Seeking professional help can mitigate stress; however, stigma can prevent help-seeking behaviors. Due to the lack of research on how help-seeking influences stress and psychological quality of life (PQOL), this relationship was explored in a college sample. It is predicted that individuals with higher stress will have better PQOL when they have positive attitudes towards help-seeking and vice versa for students with high stress and negative attitudes. College students (N = 306) completed an online survey on their psychological health. Stress was measured with Depression, Anxiety, and Stress Scales (DASS-21). The Attitudes Toward Seeking Professional Psychological Help Scale (ATSPPH-S) was used to assess help-seeking attitudes. The World Health Organization Quality of Life-Brief (WHOQOL-BREF) measured psychological quality of life. A hierarchical regression was conducted to explore the relationship between stress and psychological quality of life (PQOL), with help seeking attitudes as a moderator. Age (r = -.12*) and academic standing (r = -.12*) were added as covariates because they significantly correlated with PQOL. The overall model was significant (F (5,300) = 14.35; p < .00; R2 = .193). Direct effects of stress (p = .00) and ATSPPH-S (p = 0.21) on PQOL were found. The interaction term was significant, suggesting that ATSPPH-S significantly moderated the relationship between stress and PQOL (p = .049). Results suggest that help-seeking attitudes can improve PQOL under stressful conditions. As such, future research should explore ways to improve these attitudes to foster PQOL.

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

KAREN PEREZ-SERPA
VIRGINIA TECH /ELECTRICAL ENGINEERING
NATHAN LAM
VIRGINIA TECH /COMPUTER SCIENCE
DAVID RWIGEMA
VIRGINIA TECH /CIVIL ENGINEERING

Development of Low Cost Elbow Powered Prosthetic for Child With Upper Limb Disability

Our user is a four year old child with only a small segment of the elbow located on her left arm. With this information we had to analyze ideas as to how we can make a cost effective prosthetic that will replenish the missing portion of the child's arm. The benefit we have is also using a 3D printer so the arm can be cost-effective. By using 3D printed parts, we can develop a functional arm that's not as expensive as using myoelectric sensors for the prosthetic. The muscles that were considered the main source for enabling the mechanism of the arm was the elbow. The elbow powered prosthetic was chosen over the shoulder powered because it involved cheaper parts than the shoulder powered design along with being easier to use and apply. With our three-elbow powered prosthetic prototypes another task was scaling the size to fit the client, a four-year-old child. We started off with 60% then scaled it to 81% based on the child's given measurements. For all three designs we had we only used the 3D printed parts, string, and a rubber cover for the fingers which is a lot cheaper than using myoelectric sensors. All three designs incorporate the same mechanism which consists of putting strings through the fingers and holes which allows for the flexion of the elbow, therefore, opening and closing the hand. This study shows how a 3D printed prosthetic arm is cost effective than using myoelectric sensors for the arm.

Mentor(s): Dr. Blake Johnson (Virginia Tech, Manufacturing Systems Engineering), Janelle, Virginia Tech, Manufacturing Systems Engineering

AUTUMN PETERSON
VIRGINIA TECH /ENVIRONMENTAL SCIENCE

Increased Salinity Facilitates Higher Abundances of Freshwater Microorganisms

Freshwater salinization has slowly been recognized as an environmental problem due to an increase of agricultural practices and human driven pollution. However, little is known about how changing freshwater salinity affects freshwater microorganisms that play a key role in ecosystem functioning and are essential for biogeochemical processes. Exposure of microorganisms to altered salinity levels can impact growth patterns, survivability rates, and their functioning within the environment. In this study, we looked at how increasing concentrations of NaCl impacted survival and growth of freshwater heterotrophic bacteria. We used aerated mesocosoms to test four different conductivities [30 ïÅ_s, 250 ïÅ_s, 1250 ïÅ_s, 5000 ïÅ_s] in triplicate by adding NaCl to natural freshwater steam microbial communities. Bacterial abundance was analyzed along a two week time series using spread-plating method on Plate Count Agar to estimate Total Viable Count (TVC). We found that microbial abundance varied with salinity. Initially, abundance increased in each conductivity treatment for approximately 3 days. After 5 days, abundances in the lower salinity concentrations (30 ïÅ_s and 250 ïÅ_s) decreased, while abundance in the 5000 ïÅ_s treatments was still increasing. These results suggest that varying concentrations of salinity can significantly affect the growth and survivability of bacteria in freshwater ecosystems. Increased understanding of salt tolerance in bacteria within stream communities can improve our approach to water quality management. A next step for this research could be to look at species-specific responses to salinity increases, which we expect will have different microbial response based on microorganisms' salt tolerance and osmotic strength.

Mentor(s): Dr. Brian Badgley (Virginia Tech, Crop and Soil Environmental Sciences)

BENJAMIN RAYDEN
VIRGINIA TECH /COMPUTATIONAL MODELING AND DATA ANALYTICS

Supporting the Advancement of Virginia Based Opioid-Related Resources by Creating a User-Friendly and Consistently Aggregated Data Resource

With a marked increase in prescription and utilization of opioid-based pain management, opioid misuse has significantly increased and affects medical, legal, and public resources. While the awareness of the dangers of addiction and misuse of opioids has primarily been viewed by the general population in news or popular media, trends in overdoses, lack of concise data points, and surrounding stigma have pushed the epidemic to new populations. Few resources exist that effectively combine available public data; thus, professionals and the public have difficulties in finding accurate, interoperable, and clearly visualized data and statistics on opioid at a state level. The research presents the development of a user-friendly web interface and database that seeks to standardize and aggregate publicly existing data about opioids in Virginia in order to expedite future opioid research and make the data relatable for public consumption. Data about opioid usage and abuse in various regions and demographics in the state of Virginia were complied. Based on Virginia State Police data, it was hypothesized that adults aged 20-45 would be affected the most given the arrest record data. DEA data highlights regions with greater access to pharmaceutically prescribed opioid medications are likely to misuse, leading to higher rates of addiction and subsequent fatal overdoses when compared with VDH data. The incomplete and unconnected data sources call for resources in which users, specifically the public, can easily compare and contrast possible overdose predictors using high-end data visualizations to aid in data-powered and destigmatized information on opioids.

Mentor(s): Dr. Anne Brown (Virginia Tech, Biochemistry), Jonathan Briganti, University Libraries

KYLE REGA
VIRGINIA TECH /BIOCHEMISTRY

Argonaute 2 Knockdown Adversely Affects the Neuromuscular Junction

Multiple miRNAs play key roles in maintenance and repair of the neuromuscular junction (NMJ) through post-transcriptional gene regulation; however, little is known about the proteins that mediate their function. Here, we examined the role of Argonaute 2 (Ago2), a synaptically enriched protein that catalyzes miRNA mediated gene regulation, in the maintenance of the NMJ. Since global knockout of Ago2 is embryonic lethal, we utilized Adeno-associated virus (AAV) delivery of Cre recombinase to the tibialis anterior (TA) and extensor digitorum longus (EDL) muscles of juvenile Ago2 fl/fl;Thy1YFP transgenic mice. These mice harbor a floxed Ago2 gene that enables Cre recombinase mediated knockdown of Ago2 as well as YFP expression driven by the Thy1 promotors to visualize motor neurons. Ago2 knockdown at the NMJ at 3 weeks post-infection was verified by Ago2 immunohistochemistry (IHC), which showed decreased Ago2 localization at the NMJ in Cre AAV infected TAs versus contralateral control TAs. Analysis of NMJ morphological features following Ago2 knockdown revealed a reduction in the presynaptic areas, a modest increase in multiple axons innervating a single NMJ, and deterioration of the post synapse characterized by increased acetylcholine receptor density and fragmentation. These results suggest that Ago2 mediated gene regulation is important for both pre- and post-synaptic maintenance of the NMJ. Given its apparent role in maintaining the NMJ, Ago2 may play a critical role in mitigating deterioration of aging and ALS-afflicted NMJs. Future research will analyze Ago2 function in ALS-afflicted NMJs.

Mentor(s): Gregorio Valdez (Brown University, Neuroscience), Thomas Taetzsch, Virginia Tech, Neuroscience

SAM RODGERS
VIRGINIA TECH /BIOLOGICAL SYSTEMS ENGINEERING
EDWARD JACOBS
LAUREN HARRISON
AUSTIN ALLISON
TOM KASPUTIS

Asthma Spacers for Low to Middle Income Countries

Inhaled Corticosteroids (ICS) are the most effective therapy for asthma treatment at all ages. The most common delivery method of ICS is through the use of Metered Dose Inhalers (MDI). However, the majority of the ICS gets deposited in the pharynx and is unable to reach the lungs when using this delivery method alone. This can be aided by a valved holding chamber (Spacer). Spacers decrease ICS particle velocity, in turn aiding clearance of the pharynx, doubling drug deposition in the lung. Valve chambers are especially beneficial to pediatric patients as they are easily used with the addition of a face mask. Low income countries are often unable to afford commercial spacers, creating the need for an affordable spacer with an additional face mask for pediatric use. The device is composed of a single 3D printed part, designed as a connecting one way valve and face mask pair, attached to a plastic bottle serving as the spacer. The final design costs under 40 cents per product, and uses common recycled and donated materials for the non-3D printed parts. The device was evaluated for durability using a lung model and mechanical ventilator running through a constant cycle. The device has been proven to sufficiently decrease particle velocity, which should facilitate and increase the delivery of ICS to the lungs. In summary, this product is sufficient in providing a cost effective, simple, and cleanable solution for delivering ICS in the treatment of asthma.

Mentor(s): Dr. Muelenaer (Virginia Tech Carilion, Medicine)

CARLOS RODRIGUEZ
UNIVERSITY OF VIRGINIA/UNDECLARED

Expansion microscopy to visualize complex retinogeniculate synapses

The visual thalamus is vital for the conveyance of light-derived signals from the retina to the visual cortex. Many image-forming inputs are received by thalamocortical (TC) relay cells in the dorsal lateral geniculate nucleus (dLGN) before being reduced by activity-dependent refinement to only a few long-term inputs. Faithful transmission of image-forming information from retinal ganglion cells (RGCs) to the cortex was presumed. However, recent studies have uncovered certain TC cells that receive convergence of up to 14 RGC inputs, creating lasting complex retinogeniculate synapses. Complex synapses have been previously viewed using serial block-face scanning electron microscopy (SBFSEM), a method that uses an ultramicrotome to create detailed three-dimensional images, but the cost and preparation required for SBFSEM make it suboptimal for viewing these structures promptly. In addition to cost and time, SBFSEM cannot be easily coupled with genetic approaches to label specific subtypes of RGCs. To overcome these constraints while retaining high-resolution images, we took advantage of a novel technique known as expansion microscopy (ExM). By expanding tissue as much as five times its normal size, ExM increases the resolving power of conventional microscopes without altering the light diffraction barrier. Combination of ExM with anterograde neuronal tracing resulted in images with low signal intensity, but relatively high success was achieved when ExM was paired with specific antibody stains or genetic labeling. Unfortunately, increased sensitivity and rapid photobleaching of expanded samples pose significant issues with the practicality of ExM. Future studies aim to determine if lattice light-sheet microscopy can resolve these challenges.

Mentor(s): Dr. Michael Fox (Fralin Biomedical Research Institute at VTC, Developmental and Translational Neurobiology Center), Rachana Deven Somaiya, Fralin Biomedical Research Institute at VTC, Translational Biology, Medicine, and Health

BREONNA RUNK
VIRGINIA TECH /BIOLOGY

Investigating the Role of Iron in Plant Pathogenic Oomycetes for Novel Disease Resistance Strategies

Oomycete pathogens threaten our global food supply and ecosystems. The current use of pesticides for control is damaging to the environment, costly, and unsustainable. Growers need novel disease resistance strategies, which we aim to develop through an understanding of plant genes required by their pathogen. Alterations to such genes would inhibit the proliferation of the pathogen. We studied the interaction between biotrophic oomycete Hyaloperonospora arabidopsidis (Hpa) and model plant Arabidopsis thaliana. Iron is needed by all forms of life, and its abundance impacts the plant immune response. Our research specifically looks at genes related to iron metabolism, the regulation of iron uptake, and iron transport that Hpa might rely on for pathogen virulence. We studied the immune responses of plants with various iron related knockout genes using cytological observations and infection quantification. Removal of the iron related genes that were tested did not result in altered activation of host immune response. Mutants deficient in iron transport, such as a gene responsible for iron transport from root to shoot, demonstrated variable pathogen growth, indicating that iron partitioning plays a role in the interaction. In the future, we will study the transcription of immune marker genes to observe whether host immune activation or pathogen starvation contribute more to attenuated virulence. Gene-editing of key genes could starve pathogens of nutrients they need, offering a durable resistance strategy.

Mentor(s): John Herlihy (Virginia Tech, School of Plant and Environmental Science)

DAVID RWIGEMA MAKUZA
VIRGINIA TECH /CIVIL ENGINEERING

3D printed prosthetic-arm personalized for participant's specific birth defect

Prosthesis are very significant in society; they offer rehabilitation and mobility to those that lost their limbs. Prosthesis completes the wearer's sense of wholeness, by providing them with emotional and physical comfort as well as offering them with independency on their daily activities. We didn't know what scale to use while printing the prototype since we hadn't met the participant. We decided to present two different design with different scales for the first phase of the project (the first phase was simply to meet the participant's family and the participant limb measurement). The four-year-old participant has only just about 3 to 4 inches below the elbow, we scaled up previous design and we had to add one more design that we thought were more personalized specifically to her birth defect. A design called Kwawu Arm by Jacquin Buchanan, equipped with a hard socket which is better for somebody with a shorter residual since it provides better leverage on the socket. Furthermore, within phase 2 we had to incorporate the mechanism to allow actual usage of the prosthetic. The mechanism is the most complex aspect of the entire project, which is the only part we are still trying to improve the most on all the design especially the Kwawu Arm. Lastly, in the next and last phase, we will be improving, customizing and personalizing the prosthetic even more to meet the participant's needs and preferences using CAD software or Tinker CAD software.

Mentor(s): Blake Johnson (Department of Industrial & Systems Engineering, Virginia Tech)

CECILIA SALAZAR TERAN
VIRGINIA STATE UNIVERSITY/BIOLOGY

Using Soil Stabilizers to Reduce Water Infiltration in Vineyard Soils

The ability of Virginia to support high-quality wine grape production is often compromised by soil properties that provide an excess of water supply to the plant. This often results in vigorous vine growth that can detrimentally affect wine grape composition and potential wine quality. A solution would be to limit infiltration into the soil while minimizing erosion and allowing vapor and gas exchange. The purpose of this project was to innovate methods for reducing infiltration through laboratory testing environmentally-friendly soil stabilizing compounds which are commonly used in the construction of roads and parking lots. Such compounds have not been tested as a way to control moisture within vineyard soils. In this study, we added SoilTac and DirtGlue to soil samples of different textures at field capacity. We then measured soil evapotranspiration as the change in mass over 48 hours. Rain was simulated by sprinkling 20 mL of water from a height of 10 cm from the soil surface, after which the amount of drainage through the soil was measured every four minutes. Both compounds significantly reduced infiltration in the sandy loam soil but not the clay loam soil. DirtGlue reduced full infiltration time by 128 minutes compared to the control in the sandy loam soil and SoilTac by 107 minutes. DirtGlue did not significantly reduce evapotranspiration rates while the SoilTac significantly reduced evapotranspiration. Pending field testing, DirtGlue shows potential for reducing rain infiltration in vineyard soils.

Mentor(s): Ryan D. Stewart, Ph.D. (Virginia Tech, Department of Plant and Environmental Sciences), Jaclyn Fiola, Virginia Tech, Deparment of Plant and Environmental Sciences

ANDREA SANDERS
AMHERST COLLEGE/NEUROSCIENCE

Microcephaly-associated mutations within CASK's PDZ domain affect the CASK-syndecan-2 interaction

CASK is a gene located on the X chromosome whose encoded protein is a membrane-associated guanylate kinase (MAGUK)â€"a family of scaffold proteins that play an important role in neurodevelopment. Mutations in CASK's PDZ domain are associated with neurodevelopmental disorders like microcephaly and pontine and cerebellar hypoplasia (MICPCH). The missense mutation M519T disrupts CASK's interaction with neurexin, a disruption previously suggested to cause MICPCH. However, the mutation T529K does not interfere with CASK's ability to bind to neurexin, suggesting that CASK must be involved in some other interaction critical to normal brain development. We analyzed CASK's interaction with syndecan-2, a transmembrane heparan sulfate proteoglycan (HSPG). To move further in the investigation of CASK's function in neurodevelopment, we examined how the mutations M519T and T529K (both within CASK's PDZ domain) affect CASK's ability to bind syndecan-2. We conducted a syndecan-2-mediated recruitment assay using human embryonic kidney 293 (HEK 293) cells and an immunoprecipitation using a GFP-trap assay. An analysis of the recruitment assay indicates that syndecan-2 successfully recruits CASKWT to the membrane, fails to bind to CASKM519T, and has a weakened affinity for CASKT529K. Results from the immunoprecipitation give us a deeper understanding of the CASK-syndecan-2 interaction: syndecan-2 must be in its glycosylated form for CASK to bind to it. By evaluating syndecan-2 and its ability to bind to CASKWT, CASKM519T, and CASKT529K, we can progress towards a better understanding of CASK's role in regulating neurodevelopment.

Mentor(s): Konark Mukherjee, Ph.D. (Fralin Biomedical Research Institute at VTC, Neuroscience), Paras Patel, Fralin Biomedical Research Institute at VTC, Translational Biology, Medicine and Health Graduate Program

NIESHA SAVORY
VIRGINIA TECH /NEUROSCIENCE

Mitochondrial quantity differences across hippocampal subregions

Autism spectrum disorder (ASD) is characterized by deficits in social interaction. About 1/59 children at the age of 8 are diagnosed with autism as of 2014 (CDC, 2019.) A specific brain region may play a significant role in autism and other related diagnoses: the hippocampus. The hippocampus is essential for long term memory and spatial processing. It is separated into four subregions: CA1, CA2, CA3 and the Dentate Gyrus, all of which have different cells and different functions. The smallest region, CA2, is thought to be important for social memory. Another property of CA2 is its resistance to long term potentiation (LTP), cellular damage and death. LTP is a form of synaptic strengthening that is widely believed to be the molecular mechanism of memory storage in the brain. RNA sequencing data from our lab indicates that mitochondrial gene expression is highest in CA2 compared to neighboring hippocampal neurons. Mitochondria provide energy for neuronal functions, such as those that contribute to memory. Here we tested the hypothesis that there is a greater number of mitochondria in CA2 neurons compared with other hippocampal neurons. Mouse brain sections were immunostained for COXIV, a protein that localizes to mitochondria and is required for the generation of energy. The mitochondria in hippocampal neurons were imaged with a confocal microscope. The number of mitochondria were quantified in the image analysis program FIJI, and the number of mitochondria per cell were compared across three subregions. Identifying CA2-specific differences in mitochondria number may reveal a novel mechanism regulating CA2 resistance to LTP and its role in social memory. Understanding of the underlying biology of complex processes such as social memory may lead to new therapeutic treatments for individuals with social impairments, such as ASD.

Mentor(s): Shannon Farris (Virginia Tech Carilion, Biomedical Sciences and Pathobiology)

JOHN SCHAFER
VIRGINIA TECH /ELECTRICAL ENGINEERING
GRANT HUTCHINS
VIRGINIA TECH /AEROSPACE ENGINEERING
BEN PRITCHARD
VIRGINIA TECH /AEROSPACE ENGINEERING
ROB ENGEBRETSON
VIRGINIA TECH /AEROSPACE ENGINEERING

An OLED Smartphone Scene Generator with Total Pixel Control in Support of Virginia Tech's Space Situational Awareness (SSA) Telescope Program

The Center for Space Science and Engineering Research (Space@VT) and the Hume Center for National Security and Technology are currently commissioning an SSA telescopeâ€“the Celestron RASA 36â€“to support Virginia Tech's effort to establish a Space Situational Awareness (SSA) program. This SSA telescope will be used to track objects in Low Earth Orbit (LEO) and Geostationary Orbit (GEO). Due to the sensitivity required to identify and track objects in LEO and GEO, it is critical to have a priori knowledge of SSA instrumentation capabilities. We therefore built and commissioned an Optical Scene Generator (OSG) to simulate expected observational environments and to characterize a variety of imaging detectors that could be used for SSA applications. Using a commercially available modern android smartphone, with its open source OS and OLED screen, we have the ability to program and generate virtually any scene that can be used for camera characterization but also for simulating static or dynamic SSA environments. By uploading images to the screen or by directly controlling individual pixels via a programmed interface, we can directly measure a detector's noise characteristics, as well as its sensitivity, linearity, and overall performance. Therefore, the OSG is a critical system for both SSA observational data accuracy and optical sensor characterization. Here we present a fully commissioned OSG with a Samsung Galaxy S8 OLED smartphone which we used to characterize a Meade Deep Sky Imager IV CMOS cameraâ€“the sensor of choice for the RASA 36 telescope.

Mentor(s): Dr. Leon Harding (Virginia Tech, Space@VT/Hume center, College of Engineering)

CRAIG SCHICHTEL
VIRGINIA TECH /ELECTRICAL ENGINEERING

Mobile Robot for Overhead Transmission Line Inspection

Overhead Transmission lines distribute power to homes and businesses but are vulnerable to the outdoor environment. The outdoor environment causes damages such as abrasions and broken strands to the lines. The transmission lines require frequent maintenance to deal with damages from the environment. Transmission lines are not only hard to access, but are very expensive and working on the lines puts workers at risk. The goal of our robot is to make an inexpensive, small, and lightweight mobile damper robot which would help reduce wind damage on the transmission lines. By having less wind damage there is less maintenance needed. Currently, there are Stockbridge dampers that are put onto the lines. These help reduce the damage caused by vibrations due to the wind, but can only cover certain frequencies. The idea of the project is to have a Stockbridge damper attached to a robot that can maneuver along the transmission lines. This would enable the damper to work on a larger range of frequencies to further reduce the costly impact of wind on the lines. In the future, the plan is to make the robot self-sustainable for long periods of time by harvesting energy itself likely through solar power or electromagnetic induction.

Mentor(s): Oumar Barry (Virginia Tech, Mechanical Engineering)

DIANA SCHMIDT

The presence of PPCPs in Appalachian karst hydrology

In recent years, studies have found that pharmaceuticals and personal care products (PPCPs) are present in surface and groundwater around the globe. The effects of these compounds in aquatic ecosystems are widely unknown. The purpose of this study was to determine the presence PPCPs in agricultural and urban-impacted karst hydrology. Water samples were collected from karst hydraulic features in Southwest Virginia and underwent solid phase extraction (SPE) and UPLC/MS/MS analysis. Overall, 40 out of 140 unique compounds were positively identified with each site having between 5 and 23 compounds. Urban-impacted sites demonstrated a higher number of identifiable PPCPs than agriculturally impacted sites. These findings demonstrate a correlation between direct human influence and PPCP presence in karst hydrology and have significant applications in future karst water quality studies.

NOAH SCHRAYER
VIRGINIA TECH /BIOCHEMISTRY

Investigating the Function of GJA1-26k and the Contribution of Internal Translation to a Genetic Disorder.

Connexin 43 (Cx43) is the most ubiquitously expressed gap junction protein and enables direct intercellular communication. Mutations in GJA1 (the Cx43 gene) lead to the genetic disorder oculodentodigital dysplasia (ODDD), a syndrome with multiple physiological malformations of the teeth, craniofacial region, eyes, heart, hands, and nervous system. Many of the underlying mechanisms which cause ODDD pathologies are currently unknown. The mRNA encoding Cx43 is subject to internal translation events resulting in synthesis of up to seven N-terminally truncated isoforms arising from methionine (AUG) translation start sites within the coding sequence. In 2005 an ODDD patient was reported with a M147T Cx43 mutation, leading us to hypothesize altered internal translation initiation contributes to the ODDD phenotype. M147 is the translation start site for a 26kDa isoform of Cx43 (GJA1-26k) whose function is currently unknown. We used site-directed mutagenesis to introduce the M147T mutation and Cx43 knockout cells were transfected with wild-type and mutant constructs where western blotting confirmed loss of the GJA1-26k. Confocal immunofluorescence microscopy and transient transfection of V5-tagged GJA1-26k identified GJA1-26k within the vesicular transport pathway and localized to cell-cell borders. Given that GJA1-26k encompasses an extracellular loop, its location at cell borders raises the possibility that it may act as an adhesive protein. Future studies using transgenic animals will enable interrogation of GJA1-26k expression and function in ODDD and importantly, our work highlights the possibility that mutations may not cause disease through altering protein sequence alone, but rather how RNA is treated and translated by the cell.

Mentor(s): James Smyth (Fralin Biomedical Research Institute, Biological Sciences, Virginia Tech)

BENJAMIN SHENAL
VIRGINIA TECH /PSYCHOLOGY

Risk and Ambiguity Attitudes: Computational Modeling through Online Gamble Games

Risk and ambiguity (events with known and unknown probabilities, respectively) influence human decision making in virtually every aspect of life. Unlike risk, which has been studied extensively, researchers still do not fully understand the mechanism of ambiguous decision-making. Computational models have attempted to account for ambiguous decisions. However, most models fail to capture how individuals make decisions when all options are ambiguous, when probabilities are unevenly distributed. In this study, we design an AmazonTurk mixed gamble task with three treatments to 1) validate our ambiguity model by replicating previous findings, 2) examine the impact of different gamble designs on ambiguous decisions, and 3) test whether participants' responses are driven by cognitive load or heuristics. In a prior study, our lab developed a behavioral model to capture different types of ambiguous decisions. This model stems from loss aversion that uses a reference point to capture bidirectional behavior in ambiguous decisions and uses a power function to evaluate risk aversion. We observe that when the probability for the low payoff is below 50%, the frequency of risky decisions decreases with increasing ambiguity levels; however, we notice the opposite behavior when the probability for the low payoff is above 50%. The bidirectional behavior demonstrates the heuristic nature of how individuals view ambiguous probability, and confirms that individuals' ambiguous decisions are influenced by a reference point. These findings highlight the significance of having gamble games where the probabilities are unevenly distributed in ambiguous trials.

Mentor(s): Dr. Brooks King-Casas (Virginia Tech, Psychology)

KEVIN SHENG
ROANOKE VALLEY GOVERNOR'S SCHOOL/N/A

Investigating the Effects of the Connexin43 Mimetic Peptide JM2 on Cell Migration and Microtubule Dynamics in Glioblastoma

Glioblastoma (GBM) is a prevalent and highly malignant brain tumor that is currently incurable. The failure of current therapies lies partly in the presence of glioma stem cells (GSCs), whose self-renewing and tumorigenic properties confer resistance to temozolomide (TMZ). Our previous research has demonstrated an oncogenic role for the gap junction protein connexin43 (Cx43) in GSCs through its interaction with microtubules. Specifically, Cx43-microtubule interaction modulates directional cell migration and cell polarity, thereby promoting tumor proliferation and invasion. Selective disruption of this interaction using JM2, a mimetic peptide targeting the microtubule-binding domain in the Cx43 carboxy-terminus, results in decreased cell survival in TMZ-resistant GSCs but not in differentiated GBM cells. Given the essentiality of Cx43-microtubule interaction for cell migration, we sought to determine whether JM2 reduces migratory potential in GBM cells and GSCs and the mechanism by which JM2 may confer these effects. Using wound healing assays, we found that JM2 significantly reduced directional cell migration in GBM cell lines and patient-derived GSCs. Cell migration is a polarized process partly mediated by microtubule dynamics and stability; therefore, we assessed the impact of JM2 on microtubule dynamics in GBM cells and GSCs. JM2 was found to significantly reduce microtubule growth velocity in a Cx43 expression level-dependent manner in GBM cells and patient-derived GSCs via live cell imaging using confocal microscopy. Taken together, these results suggest that JM2 holds potential as a novel therapeutic for GBM patients targeting GBM invasion and GSCs.

Mentor(s): Dr. Samy Lamouille (Fralin Biomedical Research Institute), Dr. James Smyth, Fralin Biomedical Research Institute

BROOKE SKEENS
SOUTHWEST VIRGINIA COMMUNITY COLLEGE/PRE MED AND AN ADVANCE IN SCIENCE

Evaluation of blood packed cell volume in cattle with and without Theileria orientalis Ikeda genotype

The Asian longhorned tick is a newly discovered invasive species with the ability to feed on multiple different hosts, reproduce asexually and transmit multiple pathogens of humans and animals including Theileria orientalis. These ticks have been reported in 11 states in the eastern United States. Theileria orientalis Ikeda genotype is a parasite that causes a chronic infection in cattle as well as anemia, abortion and death across Asia, Australia, and New Zealand. Recently, cattle in Virginia died from a T. orientalis Ikeda genotype infection. Randomly selected cattle were sampled from herds and livestock markets across Virginia and other eastern states. From these samples, blood smears, packed cell volume (PCV), and realtime polymerase chain reaction (PCR) were run to help detect T. orientalis Ikeda genotype. The blood smears can detect theileriosis by a light microscopic examination. The PCVs are used to measure percentage of red blood cell volume in the blood. PCRs are more advanced by being able to detect infection in cattle two weeks before infected erythrocytes can be seen by light microscopy. We compared the PCVs of Theileria positive animals with those of Theileria negative animals. One hundred forty seven animals have had PCV and PCR. Of those, 6 animals are PCR positive. The overall average PCV is 34.9 with a range of 12.5-61.5 and the PCR positive animals averaging 33.1. There is no statistical difference between these groups using a two-tailed Student T test. Early results suggest that PCV will not be useful in identifying persistently infected animals.

Mentor(s): Kevin Lahmers (Virginia Tech, Vet Med)

OLIVIA SMITH
MONTANA STATE UNIVERSITY/NUTRITION SCIENCE

Yoga Interventions for Older Adults: A Systematic Review on Issues of Internal and External Validity through the RE-AIM Framework.

Background: Physical activity (PA) is a primary prevention strategy for obesity and diabetes, yet only 17% of older adults meet the PA Guidelines for Americans. One emergent PA intervention is yoga. However, it is unknown who is reached, what the outcomes are (effect), where and who delivers the program (adoption), program fidelity and cost (implementation), and sustainability of the program (maintenance), all of which are captured in the RE-AIM framework. Methods: Searches were conducted in PubMed, CINAHL, AgeLine, and Global Health to identify U.S.-based yoga interventions for older adults (60+years of age) with a PA outcome. Data extraction was based on RE-AIM. Results: Initially 1,113 articles were identified, and 17 articles were included in full-text review. Reach: The number of participants per study ranged from 10 to 282 participants, and participants were predominantly female (82%), 74.7 (+3.4) years of age, with a body mass index of 27.4kg/m2 (+4.4). Effect: The primary outcomes evaluated by the studies were balance (64.7%), pain (35.5%), and mobility (29.4%). Adoption: 82.4% the studies reported their intervention location (e.g., senior centers, retirement facilities, university). Thirteen studies (76.5%) reported instructor type, of which most (92.3%) were certified yoga instructors. Implementation: On average, the programs were 11 weeks long, and 24 hours (+18) in duration. Maintenance data were sparse. Conclusion: Yoga is a promising PA intervention for older adults, but there is limited information on what works and for whom. Future interventions should record a broader spectrum of information across all five dimensions of RE-AIM for increased generalizability.

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

MATTHEW SOLIMAN
UNIVERSITY OF CINCINNATI/HEALTH SCIENCES

Degradation of Legionella pneumophila gene markers in potable water during exposure to free chlorine, monochloramine, and chlorine dioxide

Detection of opportunistic pathogens such as Legionella in potable water systems are used to make maintenance and operational decisions for building plumbing systems. While culture is the â€œgold standardâ€ù for risk decision-making, molecular markers are increasingly being used to inform management actions. In an on-going field study, a facility experiencing a series of Legionnaires disease outbreaks over the last 4 years used molecular detection of Legionella spp. (23S rRNA gene) as an actionable indicator of â€œliveâ€ù and â€œpathogenicâ€ù bacteria. While using free chlorine (FC), this facility reported 14.5% of samples collected as culture-positive and 48-54%% as molecular-positive. With monochloramine, 0.9% of samples were culture-positive, while 100% of samples were molecular-positive. Risk assessment informed by culture indicated risk was much lower on monochloramine but was much greater according to the molecular assay. In this study, lab-scale experiments explored the effectiveness of FC, monochloramine, and chlorine dioxide in reducing L. pneumophila DNA detection. Disinfectants were dosed to pure culture solutions of pasteurized L. pneumophila cells at concentrations relevant to drinking water standards. Legionella gene concentrations were quantified using quantitative polymerase chain reaction (qPCR) amplicons of various lengths (78-633 base pairs) as a function of time. FC was found to most drastically reduce DNA detection, decreasing gene copies by 1.95-3.06 logs over 100 minutes, compared to less than 0.5 logs for monochloramine and chlorine dioxide over 3.9-28.8 times longer exposure. Implications of this work offer a better understanding of real-world situations involving L. pneumophila detection and how disinfectants affect molecular risk assessment indicators.

Mentor(s): William J. Rhoads (Virginia Tech, Civil and Environmental Engineering), Storme Spencer, Virginia Tech, Civil and Envioronmental Engineering

CHRISTIAN SORENSON
VIRGINIA TECH /AEROSPACE ENGINEERING

Space Weather Data Analysis: Developing software tools to aid in the search for ultra-low-frequency waves (ULFWs) by means of data visualization

Space weather impacts a broad range of major, modern technologies including navigation & communication systems, satellites, astronaut activity, and ground-based power grids. Ultra-low-frequency (ULF) waves, global scale perturbations in the near-Earth space environment, are an intriguing yet poorly understood space weather phenomenon. These waves have the potential to affect all signal traffic passing through our atmosphere and even raise flags about dangerous tectonic activity. The Autonomous Adaptive Low-Power Instrument Platform (AAL-PIP) stations, placed in a chain along the 40-degree magnetic meridian of the East Antarctic Plateau, have been collecting data in the name of finding ULF waves for the past several years. This data is comprised of measurements made by dual-frequency GPS receivers of total electron content (TEC) in the ionosphere, and of magnetic fluctuations at the Earth's surface detected by magnetometers. This instrument combination makes for a unique perspective and allows new insight into the physics of ULF waves. Additionally, this is the first analysis of its kind to utilize multiple monitoring stations in the same region, adding yet more dimensions to the data. To expedite the analysis, a MATLAB program was developed to process, superimpose, and visualize the relevant data sets. This program may serve as a first step towards a more autonomous survey tool. The aspiration of this work is to confirm the mechanism of detecting these waves in TEC data, and to learn more about how ULF waves affect the performance of GPS, satellite signals, and other critical technological infrastructure impacted by space weather.

Mentor(s): Dr. Wayne Scales (Virginia Tech, Electrical Engineering, Space@VT)

JACOB STEENIS
GRINNELL COLLEGE/PHYSICS

Neutron Captures in Borated Polyethylene: An Analysis of the Quenching Measurement Data from MicroCHANDLER at TUNL

This summer, the MicroCHANDLER particle detector was brought to the tandem accelerator at Triangle Universities Nuclear Laboratory to measure the detector's quenching factor using a beam of neutrons. Specifically, the goal was to obtain preliminary data to understand how MicroCHANDLER responds to protons that recoil off of fast neutrons. To prevent thermal neutrons from interfering with data acquisition while the beam was on, MicroCHANDLER was housed in a structure of borated polyethylene. Although this structure significantly attenuates thermal neutrons in the target room, neutron captures on hydrogen within the borated polyethylene often generate 2.2MeV gammas that can be seen in MicroCHANDLER. In fact, these neutron captures appear in the delta time plots with an exponential growth structure. Examining this growth structure reveals that setting the event window towards the beginning of the beam period will allow us to minimize the number of neutron capture gammas that register in the detector. Additionally, having identified this 2.2MeV gamma feature provides another calibration point for future runs. Overall, this study acts as a first step in determining how the turn-on of neutron captures in borated polyethylene appears in our data. More data is required to be able to see a turnover in the rate of neutron captures as the majority of neutrons have already captured in the borated polyethylene. New data would also allow us to see the exponential decay in capture rates that should immediately follow the turnover.

Mentor(s): Jonathan Link (Virginia Tech, Physics)

SENAH STEPHENS
VIRGINIA TECH /BIOCHEMISTRY

Validating a mouse line for cell specific RNA tagging

A security question asks, â€œWhat is the name of your childhood best friend?â€ù Upon answering, thank the hippocampus, for it fills a crucial role in long-term memory storage. The hippocampal region CA2 stores the social aspect of memory. It is uniquely resistant to cell death and has highly regulated synaptic plasticity. We propose that the inherent absence of plasticity in CA2 is essential for normal social memory development. Synaptic plasticity is the ability of neuronal synapses to undergo changes in strength. Plasticity depends upon local translation to provide necessary proteins for modifying synaptic strength. This study validated the Amigo2-icreER UPRT transgenic mouse line using single molecule fluorescence in situ hybridization, smFISH, which fluorescently labels single RNA molecules in fresh frozen tissue. The Amigo2-icreER UPRT mouse requires tamoxifen injections to activate the enzyme Uracil Phosphoribosyltransferase, UPRT, that tags newly synthesized RNA. Here, we performed triple label smFISH, staining for Pcp4 (CA2 marker), Uprt, and polyA (all RNA) on brain sections from the Amigo2-icreER UPRT mice and imaged area CA2 on a confocal microscope. To determine if tamoxifen dosage and time were sufficient for recombination, the ratio of Uprt:PCP4 was quantified using FIJI image analysis software. In the future, the Amigo2-icreER UPRT mouse can be used to identify and label CA2 cell specific RNAs after social behaviors with the goal of understanding how candidate RNAs regulate plasticity supporting social memory. Studies may identify new therapeutic targets for treatment of disorders where social processing is disrupted, such as in ASD.

Mentor(s): Shannon Farris (Virginia Tech, Neuroscience)

TAHJA STEWART
NORFOLK STATE UNIVERSITY/BIOLOGY

The Different Ways Bacteria Can Contribute to Agriculture

Project One: Bacterial Fruit Blotch is a cucurbit plant disease that causes the crop to rot. Acidovorax Citrulli is the bacterial pathogen that causes it. The goal of this project was to select colonies of bacteria that was collected from a watermelon plant that can be used as a biological control to combat the disease. If this were possible, planters can use this to retain more crop yield. Bacteria colonies were selected and streaked on an antibiotic plate to test for resistance. This resulted in gaining stocks of the bacteria that were resistant that can then be used for further studies. Project Two: Nitrification is caused by two main bacteria, Nitrobacter and Nitrosomonas. These bacteria are critical to the nitrogen cycle, helping to convert different forms of nitrogen. The goal of this project is to test different fertilizers that contain Urea as well as Ammonia on samples of Virginia's top soil to see how much nitrogen, ammonia, and urea is being produced. Testing these fertilizers will allow planters to grow healthier plants that will yield more crops due to the high nitrogen levels and retention. The method use was a soil incubation process over the course of several weeks. The results from this project shows the amount of each gas produced over different amounts of times left to incubate.

Mentor(s): Bingyu Zhao (Virginia Tech, Plant Pathology), W. Hunter Frame, Virginia Tech, Tidewater AREC

GRACE STRID
OREGON STATE UNIVERSITY/MATHEMATICS

Evaluation of the Effects of Interaction and Display Fidelity in Interdisciplinary Hydrology Education by Comparing Novel Interfaces

In a world where technology makes large advances quickly, the technology used in education seems to be lagging behind. The novel advent of low-cost, high-fidelity computer interfaces enables the study of infinite possibilities. The Learning Enhanced Water Assessment System, or LEWAS, is a high-frequency system for monitoring the environment, that measures nine water quantity and quality parameters on proprietary sensor suites. LEWAS delivers sensor data to the Online Watershed Learning System (OWLS) for worldwide use in the classroom. LEWAS interfaces enable study of user interaction (UI) with the LEWAS field site and data, allowing a more comprehensive understanding of hydrology that is applicable in and out of the classroom. This work aims to design, develop, and analyze novel interfaces aimed at this purpose. In addition to low-engagement options such as a passive kiosk, virtual reality (VR) will also be incorporated with the creation of an educational Virtual Environment (VE) aimed at remote learning of stream hydrology lab procedures and site engagement. The design process incorporates methods which organize user and technical requirements using attributes that are vital in engagement. For the kiosk, modern technologies including Raspberry Pi microcomputer will be utilized. Follow-on work includes a VR 180 camera and an immersive head-worn display (HWD) will be used. Past research indicates that the high interaction fidelity device utilizing VR is expected to have a greater effect when compared to the kiosk, which has a very low interaction fidelity.

Mentor(s): Dr. Vinod Lohani (Virginia Tech, Engineering Education), Jeremy Smith, (Engineering Education)

ABIGAIL SUPPLEE
OANOKE COLLEGE/ENVIRONMENTAL STUDIES AND POLITICAL SCIENCE
SHAYLA TRIANTAFILLOU
UNVERSITY OF VERMONT/ENVIRONMENTAL SCIENCES AND GEOGRAPHY

An interdisciplinary approach to visualizing the social and environmental impacts of a sinking stream system

Stream systems that are both perennial and intermittent along various stretches have unique features that can have important consequences ecologically and socially. These impacts are due to the porous geologic landscape that manifests itself as a change in discharge which affects the creek's characteristics spatially and temporally. Our research aimed to address these topics to better understand sinking creeks in general. Using an interdisciplinary approach, we measured changes in water discharge, stream morphology, biological diversity and public perceptions of this ecosystem. To visualize the stream system, we developed a model using measured discharge and publicly available USGS aerial Light Detection and Ranging data. To measure changing biodiversity, we sampled microhabitats to examine the effect of discharge on benthic macroinvertebrate communities. Finally, we deployed an online survey and completed direct observations to gauge the public's perception of the ecosystem services the stream system provides. Results indicate that the stream system indeed has a measurable effect on discharge, channel geometry, biodiversity, and public perception. This information will provide Giles County residents with an improved understanding of the unique dynamics of Sinking Creek and how the creek can be better appreciated as a public resource. Additional work could include the exploration of whether precipitation data will predict how changes in discharge affects biodiversity and societal perspectives of the stream system.

Mentor(s): Leigh-Anne Krometis, W. Cully Hession, Brian Badgley (Virginia Tech Biological Systems Engineering and Biology), Our three PIs are listed above, but we had nearly a dozen mentors

RAISSA TCHETCHO KEMAJOU
VIRGINIA STATE UNIVERSITY/BIOLOGY

Combined effects of ephaptic and gap junctional coupling during ischemia related arrhythmogenesis attenuates conduction velocity slowing

In the United States more than 1.5 million people suffer from sudden cardiac arrest annually. Many of these deaths are due to ventricular arrhythmias associated with conduction defects, often connected to cardiac ischemia. During ischemia, loss of conduction has been attributed to changes in gap junctional coupling. To treat ischemia, a peptide called rotigaptide was developed to preserve gap junction function. Despite promising results in animal studies, early clinical trials with rotigaptide have not been successful. We suggest that the trials failed due to an overlooked electrical coupling mechanism, ephaptic coupling. Ephaptic coupling electrically couples myocytes via the generation of extracellular electric fields in nano domains within intercalated disc called pernixi. We hypothesized that enhancing both ephaptic and gap junctional coupling will attenuate conduction slowing and reduce arrhythmias caused by ischemia to a greater extent than either intervention alone. More specifically, perinexal widening is associated with a reduced Ephaptic coupling and conduction velocity. Ischemia is known to widen the perinexus while calcium decreases it. Elevated calcium levels have varying effects on ephaptic coupling. We analyzed optically mapped Langendorff-perfused guinea pig hearts with four different solutions(1.25Ca/145Na, 2.0Ca/145Na -low epc and 2.0Ca/153Na, 2.0Ca/153Na - high epc), that were pretreated with 80nM rotigaptide for 15 minutes. Variations in perfusate composition were identified as an important modulator of cardiac conduction velocity. Of the four solutions, rotigaptide increased transverse conduction (CVT) with 1.25Ca/145Na and 1.25Ca/153Na compared to vehicle at baseline. However, in ischemic hearts, rotigaptide significantly slowed CVT more than vehicle only with 145/2C. In conclusion, enhancing ephaptic ionically and gap junctional coupling pharmacologically improves conduction velocity under normal conditions but not ischemia.

Mentor(s): Steven Poelzing (Virginia Tech, Translational Biology), Gregory Hoeker, David Ryan King, Virginia Tech, Translational Biology

SOPHIA TEXTORIS
VIRGINIA TECH /HUMAN DEVELOPMENT & PSYCHOLOGY

The Impact of Nonfatal Suicidality on Sibling Relationships: A Look At Stress, Distress, and Functioning

Over half of the participants reported ever having suicidal thoughts (56.3%, n = 54), and 15.6% (n = 15) reported past suicidal behavior. Participants reported lower rates of suicidal thoughts for their brother/sister (40.6%, n = 39), but higher rates of suicidal behavior (20.8%, n = 20). Roughly â…· (21.9%, n = 21) of the brother/sisters had ever been hospitalized, compared to 8.3% (n=8) of respondents. Overall, there was no statistical relationship between self-report of suicidality and perception of sibling's suicidality (_ùœ'2Å,= 2Ç_1Ç¿Æ» p = .14). However, there were significant findings based on mental illness. For participants who reported that they have been diagnosed with MI, but not their sibling, none indicated any history of suicidal thoughts or behavior for their sibling. Although 70% of participants indicated their own past suicidality, all reported that their brother/sister (to the best of the respondents' knowledge) had never experienced any suicidal thoughts or behavior. For participants who reported that their sibling has had a diagnosis of MI, but they have not (Sib-MI; n = 26), 7 reported that they themselves have experienced suicidal thoughts or behaviors. All 7 who indicated their own suicidality also reported that their brother/sister has experienced suicidal thoughts or behavior, as well (_ùœ'2Å,= 5Ç'0È_Æ¿ p = .02). For respondents who reported that both they and their sibling have been diagnosed with MI, there was a significant relationship between self and sibling suicidality (p = .01). This indicates that participants are more likely to â€œmatchâ€ù with their siblings; participants who have or have never experienced suicidal thoughts or behavior themselves are likely to report the same pattern for their siblings.

Mentor(s): Carolyn Shivers (HDFS)

STEPHANIE TOOLE
CALIFORNIA STATE UNIVERSITY, NORTHRIDGE/PHYSICS

Using Cosmic Ray Veto to Increase Radiation Sensitivity at KURF

Particle interactions that can be characterized by specific amounts of energy deposited in a detector make radiation detection an essential aspect of particle physics. Colliding cosmic rays can produce high energy muons that cause considerable background for particle detectors that are studying neutrinos, double beta decay, and radiation, limiting the sensitivity of detectors. Working underground significantly reduces this problem, but muons can travel up to 10 km in air and penetrate the Earth. A muon detector built by the Center for Neutrino Physics at Virginia Tech is placed on top of a germanium detector below 300 feet of limestone at Kimballton Underground Research Facility (KURF) working as a sub-detector. Since it is not possible to shield this germanium detector from muons while it studies radiation, the muon detector provides us with the ability to accurately classify muons that pass through the germanium detector and veto, or delete, these false hits from the radiation data collected. Serving this purpose, the muon detector improves the efficiency of the germanium detector, increases the radiopurity of the samples that are tested, and results in a reduction of background noise in the collected data.

Mentor(s): Camillo Mariani (Virginia Tech, Physics), Stefano Dell'Oro, Virginia Tech, Physics. Thomas O'Donnell, Virginia Tech, Physics

TAYLAN TUNCKANAT
VIRGINIA TECH /BIOCHEMISTRY

In vitro characterization of Lysine-2,3-aminomutase from Methanococcus maripaludis

Methanogenic archaea synthesize or accumulate compatible solutes to allow their survival in high salinity environments. Although several mechanisms exist, the biosynthesis of NïÅ¥-acetyl-ïÅ¢-lysine is a common method to combat osmotic stress in marine methanogens. The two-step process begins with the conversion of Î±-lysine to ïÅ¢-lysine by lysine-2,3-aminomutase (LAM) followed by acetylation by lysine-acetyltransferase. LAM is of special interest as it belongs to the radical S-adenosyl-L-methionine (SAM) superfamily of enzymes which perform diverse and complex chemistry. Although bacterial versions of LAM have been well-characterized, a methanogenic LAM has never been studied in vitro. Here, we report on the recombinant expression, purification, and enzymatic properties of LAM from Methanococcus maripaludis. The gene encoding LAM from M. maripaludis C7 (MmarC7_0106) was cloned into pET15b and overexpressed in Escherichia coli. The his-tagged recombinant enzyme was purified by metal-affinity chromatography under strictly anaerobic conditions. After purification and reductive incubation, the protein was brown in color, had a UV-Vis spectrum characteristic of [4Fe-4S] cluster, and had 3.93 mol iron per monomer. The purified enzyme catalyzes the conversion of L-lysine to ïÅ¢-lysine in a reaction that is dependent on SAM and dithionite. At 22 ï‚°C, this methanogenic LAM has a kcat = 0.33 s-1 and a Km = 19.5 mM. Future work will include pH-activity profile studies and investigating other amino acids as substrates for the aminomutation reaction.

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

CATHERINE TWYMAN
SHAUNNA YOUNG
WILLIAM FLEMING HIGH SCHOOL /EARTH/ENVIRONMENTAL SCIENCE
RACHELLE RASCO
CARROLL COUNTY HIGH SCHOOL /STEM LAB MANAGER
KATIE HOLCOMB
PATRICK HENRY HIGH SCHOOL /BIOLOGY
STEVE AHN
HOLSTON HIGH SCHOOL /ENVIRONMENTAL SCIENCE

Teachers Supporting Teachers: Piloting a Master Teacher program within an NSF/Research Experiences for Teachers (RET) Program

Since 2017, the Water ECubeG (Engineering, Ecology, Environment, Geosciences) Research Experience for Teachers (RET) Site, supported by the NSF, at Virginia Tech has provided high school and community college STEM teachers opportunities to conduct research in water science and engineering and to develop educational materials for dissemination with their peers within and outside southwest Virginia. The Site has trained 25 teachers at the end of summer 2019. Two of the challenges of the RET program are documentation and dissemination of these educational materials after the program ends. To address these, a Master Teacher (MT) program was piloted in summer 2019 and five RET scholars from previous cohorts served as Master Teachers. The MTs assumed a leadership role and mentored current and past RET scholars in the design and documentation of innovative instructional designs. These MTs will reflect on their experiences in this poster. The RET Site activities will be published on the Learning Enhanced Watershed Assessment System (LEWAS) website and TeachEngineering.org.

Mentor(s): Vinod Lohani (Virginia Tech, Engineering Education)

COLLEEN VALENTINE
VIRGINIA TECH /CLINICAL NEUROSCIENCE

Effects of eccentric skeletal muscle loading on tendon adaptation: A Preliminary Histological Analysis

Eccentric loading of the Achilles muscle-tendon unit is commonly achieved using the “heel drop” exercise and is an effective physical therapy for symptomatic human tendinopathies. However, the mechanisms by which the presumed healing occurs are not well understood in the physical therapy field. Therefore, the objective of the present study was to develop a murine model of eccentric hind limb muscle loading for the investigation of Achilles musculotendinous adaptation. A murine IACUC-approved heel drop protocol was developed and carried out on 12 to 15-week old male C57Bl/6 mice. Two levels of muscle stimulation were investigated at 50Hz and 100Hz along with a sham group. Mice were treated twice weekly for three weeks with three sets of ten heel drop repetitions. Outcome measures included muscle strength and biomechanical analysis and this project analyzed the preliminary histology of the Achilles muscle-tendon junction. The sham group, no heel drop, was expected to not have any discrepancies and appear as a normal limb in comparison to the 50Hz and 100Hz groups. The expected outcome was that the 100Hz would not cause a tendon injury, thus the 50Hz would surely not show a tendon injury. The successful development of an eccentric muscle loading protocol for mouse hindlimbs will facilitate detailed examination of tissue and cell-level responses of the musculotendinous unit to various loading conditions and can help with physical therapy understandings in humans. This novel approach can be further paired with biological and chemical approaches to treating tendinopathy.

Mentor(s): Vincent Wang (Virginia Tech, Biomedical Engineering and Mechanics), Linda Dahlgren, Virginia Maryland College of Veterinary Medicine, Large Animal Surgery

WILLIAM VAUGHN
VIRGINIA TECH /CHEMISTRY

Bioinspired polymers for sequestration of doxorubicin during chemotherapy treatment

Liver cancer remains the third leading cause of cancer mortality in the United States. Liver cancer treatment often involves administering a chemotherapeutic agent, such as doxorubicin (DOX), during a transarterial chemoembolization (TACE) procedure. In this procedure DOX is released via a catheter in the tumor maximizing the amount of chemotherapy that reaches the tumor; however, DOX still enters systemic circulation, causing off target toxicity. We are developing polymers with pendant nucleobases to bind to DOX in the bloodstream before it leaves the liver and causes off-target side-effects. Nucleobase-containing polymers were prepared via free radical polymerization of acrylates with pendant adenine and thymine. The monomers and polymers were characterized by 1H NMR, 13C NMR, and size-exclusion chromatography. The binding efficiencies of the polymers and DOX were analyzed via DOX capture experiments were run. The nucleobase-containing polymers will also be attached to a polymer film for analysis of DOX capture. The polymers bound to surfaces will be tested in water, buffer solution, and human serum. After the analysis of thymine and adenine polymers, guanine and cytosine monomers will be synthesized and tested similarly. Finally, combinations of polymers will be tested.

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

MARIA VILLAFUERTE
VIRGINIA TECH /CLINICAL NEUROSCIENCE

Neurodevelopmental Consequences of Early Life Ethanol Exposure

Early-life ethanol exposure is associated with a sequence of negative neurodevelopmental consequences that, in turn, cause behavioral differences in offspring. Here, we hypothesize that exposure to ethanol during development will alter anxiety- and depression-like behaviors in the adult offspring compared to controls. The current study involves two experiments where animals were exposed to ethanol in utero during gestational age (G) 12.5 or postnatal day (PND) 1. The exposed offspring were weaned at PND 21 and tested for anxiety- and depression-like behaviors starting at PND 60. Since maternal care has a strong effect on the developing brain and subsequent behavior, we observed maternal behavior and found no major differences in mothers given ethanol compared to mothers given normal drinking water ($p>0.05$). In the G12.5 experiment, we found that ethanol-exposed animals spend less time with another rat in the social interaction test compared to controls ($p<0.05$). In the PND1 experiment, we found that ethanol-exposed animals spend more time in the open arms in the elevated plus maze, spend more time rearing in the open field test, spend more time immobile in the forced swim test, spend more time grooming in the splash test, and consume more sucrose in the sucrose preference test compared to controls ($p<0.05$). Further research on this project will investigate glutamatergic synapse-related gene expression (e.g., NR2A and VGLUT1) in brain regions associated with the emotional brain (e.g., hippocampus and nucleus accumbens) that may be mediating the altered behavior that we observe in the ethanol-exposed animals compared to controls.

Mentor(s): Sarah Clinton (Virginia Tech, Neuroscience)

GIANNI VILLEGAS
SUNY OSWEGO/BIOLOGY

Elucidating NLRX1 as an Alternative Tumor Therapeutic

Recent research suggests NLRX1 is a promising protein to negatively regulate tumor progression by better understanding its most critical role in mitochondrial respiration. Narrowing down NLRX1's complex roles in mitochondria will allow for further investigation into the plausibility of therapeutic use. Murine N2A Cell Lines are an appropriate preclinical model to study the cellular physiology of neuroblastomas. Neuroblastomas are the most common physical tumor (~50%) amongst infants and amount to 20,000 US cases annually. NLRX1 is known to have a tripartite domain structure consisting of: an unknown N-Terminus variable domain, Central NACHT domain, and C-Terminus Leucine-Rich Repeat domain. It's proposed that tumors can be regulated by controlling the cell's energy consumption. Hypothesis: Over-expression of NLRX1 will lead to N2A cell death at greater rates than wild-type or knock-down N2A cell lines. The aim of this study is to manipulate the gene expression levels of NLRX1 in N2A cells and monitor cell survival and energy consumption to better understand the true underlying role of NLRX1 in relation to the mitochondrion. A sub-aim of this study is to complete a hydrogen peroxide cell challenge in order to stimulate regulation of reactive oxygen species within the cell by NLRX1. NLRX1 was tagged with GFP, over-expressed, or knocked-down via use of a scramble control, lipofectamine transfection, and lentiviral transfection, respectfully. The gene expression levels of the cell lines were assessed via protein immunoblot (Western Blot). A mitochondrial stress test (Seahorse Assay) was administered to indirectly monitor cellular energy consumption via oxygen consumption rates.

Mentor(s): Irving Coy Allen (Inflammatory Disease Research Facility (IDRF))

RACHAEL WALCHECK
IOWA STATE UNIVERSITY/MICROBIOLOGY

Collection of Volatile Compounds from Arachis hypogaea infected with Sclerotium rolfsii

Peanut (Arachis hypogaea), is a major crop in the southeastern U.S., but fungal diseases are a major constraint to production. Stem rot, a soilborne disease caused by Sclerotium rolfsii, can cause peanut yield losses of up to 80%. During infection, plants release signaling chemicals, called volatile compounds, that indicate plant stress and can help inhibit pathogen growth. We hypothesized that volatiles produced during infection would differ from those released by a non-infected Arachis hypogaea plant. To test this hypothesis, we collected the volatiles from nine A. hypogaea plants inoculated with S. rolfsii and three non-inoculated A. hypogaea plants using a circulation pump that collects volatiles in a charcoal trap. The charcoal trap was then eluted with bromodecane and analyzed using a gas chromatograph mass spectrometer. The microbial volatile compound, 1-octen-3-ol, was detected in the headspace of infected A. hypogaea plants and also from the headspace of S. rolfsii cultures. Detection of this fungal-specific compound indicates that the pathogen is present on the plant. Other volatile compounds detected, including linalool and methyl salicylate, are plant derived compounds that are released in response to plant stress. Both of these volatiles are known to aid in inhibiting pathogen growth. Identification of specific volatile compounds produced by A. hypogaea plants infected with S. rolfsii may lead to the development of a method for early detection of stem rot in peanut fields. If stem rot is detected early enough, farmers can use preventative fungicide applications to prevent further infection.

Mentor(s): Dorothea Tholl (Virginia Tech, Chemical Ecology), Hillary Mehl, Virginia Tech, Plant Pathology

ADDISON WEBSTER
VIRGINIA TECH /EXPERIMENTAL NEUROSCIENCE

Hypothalamic mechanism of neuropeptide S-induced satiety

Neuropeptide S (NPS), a 20 residue neurotransmitter, is found in the brains of multiple species and is associated with reduced food intake when centrally injected into mammals. Our group was the first to report this anorexigenic effect in birds using chicken as a model, although the hypothalamic mechanism of NPS-induced satiety is unknown in any species. Thus, we designed the present study to elucidate the hypothalamic mechanism of NPS-induced satiety in Japanese Quail (Coturnix japonica). In Experiment 1, quail intracerebroventricularly (ICV) injected with NPS reduced both food and water intake. In Experiment 2, NPS-injected quail had reduced feeding and exploratory pecks and increased head shaking, but other behaviors were not affected. In Experiment 3, we quantified the early intermediate gene product c-Fos (as a marker of neuronal activation) in key appetite associated hypothalamic nuclei and found that only the paraventricular nucleus (PVN) was reactive. We are currently in the process of conducting Experiment 4, where real-time PCR is being used to screen for various neurotransmitters changes within the PVN of NPS-injected quail. After the completion of Experiment 4, a model of the hypothalamic mechanism of NPS-induced satiety should emerge.

Mentor(s): Mark Cline (Animal and Poultry Science)

JESSICA WEI
VIRGINIA TECH CARILION RESEARCH INSTITUTE/UNDECIDED

A Diverse Cytoarchitecture Forms Hidden Laminae in the Ventral Lateral Geniculate Nucleus

The only connection between the eye and brain arises from retinal ganglion cells, whose axons form the optic nerve and innervate different regions of the brain, telling it everything it will ever know about the visual world. In mice, these retinal axons transmit visual information to the visual thalamus, which is composed of the dorsal lateral geniculate nucleus (dLGN) and ventral LGN (vLGN). The dLGN has been the focus of many studies and much is known about its roles in processing and transmitting image-forming visual information. In stark contrast, much less is known about the vLGN, which receives and processes non-image-forming visual information. So far, no studies have systematically examined the differences between the cytoarchitectures of these two nuclei. Our preliminary data show that not only do the cells in the vLGN make it unique from dLGN, but they appear to spatially organize in distinct ways as well. In this study, we test the hypothesis that unique cell types reside in the vLGN and arrange into laminar-like restricted spatial zones. This was done by labelling the cells with canonical and novel cell type markers (obtained from RNAseq) using immunohistochemistry and in situ hybridization. The antibodies used were raised against parvalbumin, calbindin, somatostatin, and Iba1 (microglia), and the riboprobe was generated against proenkephalin. The cell type expression patterns were quantified by dividing the vLGN into four quadrants to calculate their density and spatial distribution. These findings strongly suggest diverse and organized cytoarchitecture underlying the vLGN's unique role in visual information processing.

Mentor(s): Ubadah Sabbagh (Virginia Tech Carilion Research Institute, Department of Translational Biology, Medicine, and Health)

KEVIN WILLIAMS
VIRGINIA TECH /BIOCHEMISTRY

Global characterization of Fusobacterium virulence proteins using genomics, bioinformatics, and cellular microbiology

Bacteria of the genus Fusobacterium are Gram-negative, anaerobic bacteria that predominantly reside in the oral cavity. Fusobacterium nucleatum has recently gained notoriety as an â€˜Oncomicrobe' with connections to oral, pancreatic, and colorectal cancers. To understand how these normally commensal bacteria participate in opportunistic infections and diseases, the goal of my project was to sequence bacterial genomes to allow the prediction of virulence proteins that could be aiding in infection. In addition, these bacteria were to be used to infect human cells to compare our predicted virulence capabilities to actual experimental results. In addition I participated in enhancing a bacterial genetic system for Fusobacterium by recombinantly expressing and purifying Fusobacterium DNA methyltransferase enzymes to protect DNA prior to bacterial transformation. These experiments are key to gaining a deeper understanding of how Fusobacterium is involved in oral diseases and cancer, as well as how we can use this knowledge for improved treatments and disease prevention.

Mentor(s): Daniel Slade (Virginia Tech, Biochemistry)

MITCH WOODHOUSE
VIRGINIA TECH /BIOLOGICAL SYSTEMS ENGINEERING
SHANNON KATE BARRETT-JOHNSON
VIRGINIA TECH /COMPUTER SCIENCE
MATTHEW TRANG
VIRGINIA TECH /ELECTRICAL ENGINEERING
KAILEY KINSLOW
VIRGINIA TECH /INDUSTRIAL SYSTEMS ENGINEERING
ANVITHA NACHIAPPAN
VIRGINIA TECH /INDUSTRIAL SYSTEMS ENGINEERING

Use of a Clicker Band in Aiding an Individual Affected by a Spinal Cord Injury

The purpose of this project is to design a device to assist Subject Matter Expert Tucker Winfrey in his daily life. Mr. Winfrey is paralyzed from the chest down due to a C4 spinal cord injury and has limited hand movement. Thus, he has difficulty operating a mouse in his daily use as a student at Virginia Tech. In order to assist Mr. Winfrey, a wearable â€˜Clicker Band' was developed, allowing him to click with his left hand while maneuvering the mouse with his right hand. The effectiveness of this Clicker Band was tested through a series of speed and accuracy tests and the effect of the device on efficiency and click accuracy was analyzed. Experimental results show that the device has a positive impact on his ability to click and navigate in his daily work. Mr. Winfrey has also indicated that he has experienced a sizeable increase in ease of use when operating his computer with the device. Thus, this device is a useful asset to Mr. Winfrey, and will benefit him in his daily life.

ROWAN WOOLDRIDGE
VIRGINIA TECH /BIOCHEMISTRY

In vitro characterization of Sinorhizobium meliloti Methyl Accepting Chemotaxis Proteins McpW and McpZ

Plants cannot obtain nitrogen themselves, even though it is an essential nutrient for them. In some cases, plants such as Medicago sativa (alfalfa) form a symbiotic relationship with bacteria such as Sinorhizobium meliloti in which nitrogen from the atmosphere is fixed by S. meliloti for alfalfa to use. Alfalfa releases specific exudates into the surrounding soil to attract S. meliloti through a process called chemotaxis. S. meliloti possesses genes coding for 8 putative chemoreceptors, called Methyl-accepting Chemotaxis Proteins (MCPs), five of which remain uncharacterized. This project investigated the specific ligand(s) that bind to two of the remaining five chemoreceptors McpW and McpZ. In order to study this, the genes coding for the ligand binding domain of these MCPs were cloned into four different vectors, overexpressed within Escherichia coli cells, and purified using column chromatography (affinity, size exclusion). Once purified, both proteins were to be analyzed using differential scanning fluorimetry (DSF) to determine specific ligand(s) that bind to them. It was revealed that there was soluble protein expression when the genes coding for McpW and McpZ were cloned in the vectors pTYB11 and pKLD66. Purifying McpW using IMPACT affinity column chromatography resulted in protein concentrations too low to analyze by DSF. Purification of McpW needs to be optimized for final analysis by DSF, and McpZ has yet to be purified. A better understanding of chemotaxis could lead to its optimization so that soil could be naturally enriched with nitrogen thus reducing the need for chemical fertilizers that harm our ecosystems.

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

MICHELLE WOREK
VIRGINIA TECH /GEOSCIENCES

Crystal Formation onto an Organic Matrix: Effect of pH on Nucleation Rate and Polymorphs of Calcium Carbonate

Organisms synthesize skeletal structures as mineral-organic composites through biomineralization. Calcium carbonate (CaCO3) is the most abundant biomineral in the ocean and typically occurs as the three most common polymorphsâ€" aragonite, calcite, or vaterite. Progressive acidification of world oceans raises the question of how decreasing pH will impact the rate and types of CaCO3 polymorphs that form. We hypothesized decreasing pH influences the type of polymorph precipitated onto an organic matrix and the nucleation rate. Experiments were conducted using gelatin as a simple model for an organic matrix, which was mounted in a flow-through cell using CaCl2 and Na-HCO3 solutions. The pH of each bicarbonate solution was adjusted to 8.98, 9.32, or 9.90. Crystallite formation was recorded with an optical microscope to determine nucleation rate. SEM and XRD were used to characterize the resulting polymorphs. For the control system, vaterite formation is predominant at all pH conditions, with variable amounts of aragonite and calcite. The nucleation rate decreases with pH where rates at pH = 8.98 are approximately 50% of rates at pH = 9.90. With the introduction of MgCl2, aragonite is the only polymorph to form. The aragonite nucleation rate is approximately 2X faster than the control experiments for all pH conditions; the rate is pH dependent with slowest rates at the lowest pH. Additional experiments will determine the pH influence on chitosan as an organic matrix.The rate of CaCO3 formation in oceans, and the resulting polymorphs, may be compromised or inhibited due to progressive acidification of marine environments.

Mentor(s): Patricia Dove (Virginia Tech, Geosciences), Nizhou Han, Virginia Tech, Geosciences

TERRELL WORRELL
VIRGINIA TECH /ENGINEERING SCIENCE AND MECHANICS

Study of Gliding Chrysopelea body orientations and resulting aerodynamics during shallow glide stages with 3D imaging camera arrays

Flying snakes, Chrysopelea paradisi and Chrysopelea ornata, exhibit surprisingly proficient gliding given their stark differences from other, more traditional, gliders. They perform these glides using a variety of morphological and behavioral adaptations and, when conditions are right, can enter shallow, steady glide stages. Right now, we know that the snake uses body segments to generate lift while undulating through the air but are unsure of the aerodynamic interactions between these body segments. Knowing the snakes' body positions with high accuracy during these shallow glide stages are important to determine the aerodynamic forces acting on the snake. Using an array of synced cameras, we will film C. paradisi and C. ornata from below their shallow glide stage to 3D triangulate specific and regular markers on the snakes. Powerful video analysis software will be used with splining techniques to create still models of the gliding snakes. This will allow for a more complete understanding of the forces acting on the snake and the effects of body movement during the shallow glide stage.

Mentor(s): Dr. Jake Socha (Biomedical Engineering and Mechanics)

LYNSEY WYATT
ROANOKE COLLEGE/PSYCHOLOGY

Differences in word production during intensive movement therapy

Statement: This study examined changes in word production during intensive movement therapy (IMT) for children with hemiparesis between the ages 6-36 months. Purpose: In recent years, studies have shown a strong relationship between early language performance and motor development (Oudgenoeg-Paz et al. 2012, Houwen et al. 2016). Neuropsychological data demonstrate a functional link between neural activation of hand and speech production areas of the motor cortex (Meister et al., 2003). Interestingly, parents of children receiving IMT often note increased language production during and after treatment (Ramey et al. 2013). In this study, we measured word production at the start and end of IMT for children with hemiparesis who often demonstrate delays in language and communications skills (Otapowicz et al., 2010). We hypothesized that word production would increase during IMT because of the relationship between motor and language abilities. Methods: Verbal and sign language word production was counted from randomly selected video clips (10mins in length) of 17 children (age 6-36 months; M=23.9, SD=5.1) receiving IMT (3-6 hours/day, 5 days/week for 4 weeks). Clips were drawn from week 1 and week 4. We further analyzed the data comparing 8 infants 6-24 months (M=19.4 SD=2.9) to 9 toddlers 24-36 months (M=28.0, SD=2.9). Results: Significant increases in word production from week 1 to week 4 were observed with a mean change of M=24.4, SD=21.3 $t(16)=4.57$ $p<0.001$. There was no significant difference based on age. Our findings support our hypothesis that word count increases during IMT.

Mentor(s): Stephanie DeLuca, PhD (Fralin Biomedical Research Institute at Virginia Tech, Neuromotor Research Clinic & Virginia Tech Carilion School of Medicine, Department of Pediatrics)

AJONI WYNN-FLOYD
RADFORD UNIVERSITY/MARKETING

The exploration of Martin Luther King Jr in public art: Agency and Interpretation

This research will explore the extent to which viewers incorporate previous life experiences while interpreting works of art. Similarly, commissioners of public art projects often have their own agendas and provide specific instructions for the projects. Agency impacts the meaning of public art projects. What are the variety of agendas at play and what do they mean? This was established by analyzing articles from 1965 to present day from various news outlets, discovering the commentary of statues and murals, and examining why they were created. After Martin Luther King Jr's death, he was made into a martyr. At said martyr status his influence became recognized nationally. The expected results are to be a high rate of criticism which incorporate personal agendas and agency interference throughout the world. In most cases the artworks were alleged to be notions to express appreciation for Martin Luther King Jr's freedom fighting. Various frames of King range from being presented from a commissioner's intended stance of peace and love to the frame of appeasement in communities that have been disrupted due to urban development. Furthermore, the importance of analyzing art composition and agency framing is key to aesthetic reception.

Mentor(s): Kevin Concannon (Virginia Tech, Visual Arts)