VIRGINIA TECH'S OFFICE of

UNDERGRADUATE RESEARCH SUMMER SYMPOSIUM

ABSTRACTS

Goodwin Hall / July 27, 2017, 9:00am - 4:30pm

Schedule at-a-glance

8:30-9:00am	**Registration + Poster Session 1 set-up** GOODWIN HALL ATRIUM
9:00-9:30am	**Welcome + Keynote Address** GOODWIN HALL AUDITORIUM
	Welcome KERI SWABY Undergraduate Research Coordinator
	Introduction SOPHIA LEE Senior majoring in Environmental Science; Peer Mentor + Undergraduate Research Ambassador
	Keynote DR. THANASSIS RIKAKIS Executive Vice-President + Provost of Virginia Tech
9:30-10:30am	**Poster Session 1** GOODWIN HALL ATRIUM
10:30-10:40am	**Break + Poster Session 1 Breakdown**
10:40am-12:00pm	**Oral Presentation Showcase 1** GOODWIN HALL AUDITORIUM
12:00-1:00pm	**Lunch** GOODWIN HALL ATRIUM
	Graduate School Networking
	Poster Session 2 set-up
1:00-2:00pm	**Poster Session 2** GOODWIN HALL ATRIUM
2:00-2:10pm	**Break, Poster Session 2 Breakdown, Poster Session 3 set-up**
2:10-3:30pm	**Oral Presentation Showcase 2** GOODWIN HALL AUDITORIUM
3:30-4:30pm	**Poster Session 3** GOODWIN HALL ATRIUM
4:30pm	**Closing Remarks** KERI SWABY Undergraduate Research Coordinator

Jill C. Sible, Ph.D.
Assistant 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 a 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, Melissa Ripepi, and our peer mentors for their tremendous work in making this symposium happen!

Enjoy!

Jill C. Sible, Ph.D.
Assistant Provost for Undergraduate Education

Office of Undergraduate Research

Keri Swaby
University Undergraduate Research Coordinator

Welcome to the annual Summer Research Conference at Virginia Tech! We are extremely excited to welcome 134 presenters from 13 organized research programs and many independent labs, who will give 10 oral and 127 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, have been engaged in a wide variety of projects tackling real world problems in multiple 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, communicating science, and presenting research. Guest speakers came from University Libraries, the Center for Communicating Science, University Honors, the Graduate School, and faculty from a variety of internal and external programs. We are extremely grateful for their time and for sharing their expertise.

But, this summer was not only about research and professional growth. This summer, researchers were invited to weekly Friday field trips to visit VT labs and facilities including the VTCRI, Kentland Farms and the drone facility, TREC lab, Hokie Stone Quarry, ICAT, and the VT Food Pilot Processing Plant, as well as social outings to hike, eat dinner, listen to live music, participate in local festivals, tube on the New River, and several cookouts. These activities were facilitated by four energetic peer mentors, Gabby, Matt, Ryan and Sophia, who tirelessly planned events and activities to ensure that a fun time would be had by all. Without these dedicated students and the expert direction and immeasurable effort of Melissa Ripepi, this summer would not have been a success. Thank you all of your incredibly hard work.

The operations of the OUR would not have been possible without generous financial support from the Fralin Life Science Institute and the Office of the VP for Research. 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
University Undergraduate
Research Coordinator

Keynote Address

EXECUTIVE VICE-PRESIDENT & PROVOST, DR. THANASSIS RIKAKIS

Dr. Thanassis Rikakis

Thanassis Rikakis joined Virginia Tech in August 2015 as executive vice president and provost. He is also a tenured professor in the Department of Biomedical Engineering and Mechanics in the College of Engineering and holds a joint appointment as a music professor in the School of Performing Arts in the College of Liberal Arts and Human Sciences.

From 2012 to 2015, Rikakis served as vice provost for design, arts, and technology at Carnegie Mellon University, where he coordinated the development of the Integrative Design, Arts, and Technology Network—a network that engaged more than 70 faculty from 15 different university departments and units.

A member of the Arizona State University faculty from 2001 to 2012, Rikakis was named founding director of the university's School of Arts, Media, and Engineering in 2003. He also held a faculty appointment at Columbia University from 1995 to 2001. Rikakis received his doctor of musical arts degree in music composition and a master of arts degree in music composition from Columbia University. He received his bachelor of arts degree in music composition from Ithaca College.

2017 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. This year's recipients and their projects are listed below.

Alexander Bala *(Architecture)*
INFORMAL ENVIRONMENTS: A CASE STUDY OF THE HANSENS' HOUSE AND THE TRADITION OF "OPEN FORM" ARCHITECTURE
Faculty mentor: Margarita McGrath, associate professor of architecture

Airiel Barrientos *(Landscape Architecture)*
INTERNATIONAL BUILT ENVIRONMENTS
Faculty mentor: Cermetrius Bohannon, assistant professor of Landscape Architecture

Connor Brown *(Biochemistry)*
DO SUBTLE BIASES AFFECT THE RECRUITMENT OF COMMUNITY COLLEGE STUDENTS TO STEM UNDERGRADUATE RESEARCH OPPORTUNITIES?
Faculty mentor: Jody Thompson Marshall, Director of Multicultural Academic Opportunities Program

Ahmed Elnahhas *(Mechanical Engineering)*
SORTING CELLS WITH ACOUSTICS: DESIGN, FABRICATION AND OPERATION OF ACOUSTIC MICROFLUIDIC CELL SORTER
Faculty mentor: Shima Shahab, assistant professor of biomedical engineering + mechanics

Rebecca Good *(Landscape Architecture)*
HONG KONG'S USE OF PUBLIC SPACE
Faculty mentor: Cermetrius Bohannon, assistant professor of Landscape Architecture

Logan Healy *(Architecture)*
ANALYSIS OF THE SUSTAINABILITY AND INFRASTRUCTURAL RESTRUCTURING OF FORMER OPEN PIT MINES
Faculty mentor: Willaim Galloway associate professor of architecture

Michael Rhoades *(SOVA - Creative Technologies)*
AUDIO/VISUAL SPATIALIZATION IN THE CUBE
Faculty mentor: Dane Webster, associate professor of visual art

Thank you . . .

PEER MENTORS

Matt Jones
Sophia Lee
Ryan Lupi
Gabby Scalzo

STUDENT ASSISTANT

Jack Hartley

PROGRAM DIRECTORS

FRALIN SUMMER UNDERGRADUATE RESEARCH FELLOWSHIP
Keri Swaby (Office of Undergraduate Research)

GLOBAL FORUM UNDERGRADUATE SUMMER RESEARCH LAB
Dr. Jim Bohland (Global Forum on Urban + Regional Resilience)

INTERDISCIPLINARY WATER SCIENCES AND ENGINEERING REU
Vinod K Lohani (Engineering Education)

RET: BIOMECHANICS FROM MOLECULAR TO ORGANISMAL SCALES
Jake Socha (Biomedical Engineering + Mechanics)

SPACE@VT
Robert Clauer, Scott Bailey (Electrical + Computer Engineering)

TRANSLATIONAL OBESITY UNDERGRADUATE RESEARCH SCHOLARS
Deborah Good (Human Nutrition, Foods, + Exercise)

VIRGINIA TECH-VIRGINIA COMMUNITY COLLEGE SYSTEM BRIDGES TO THE BACCALAUREATE PROGRAM
Karen Eley Sanders (Associate Vice Provost for College Access),
Kristy Collins (Biocomplexity Institute)

VT-REEL/SURF
Glenda Gillaspy (Biochemistry)

VTCRI MOLECULAR VISUALIZATION SURF
James W. Smyth (VTCRI + VT Biological Sciences)

VTCRI *neuro*SURF
Michael Fox (VTCRI + VT Biological Sciences)

WATER ECubeG RET- ICTAS
Dr. Vinod K Lohani (Engineering Education + ICTAS)
Dr. Randy Dymond (Civil + Environmental Engineering)

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 RECRUITMENT + DIVERSITY INITIATIVES

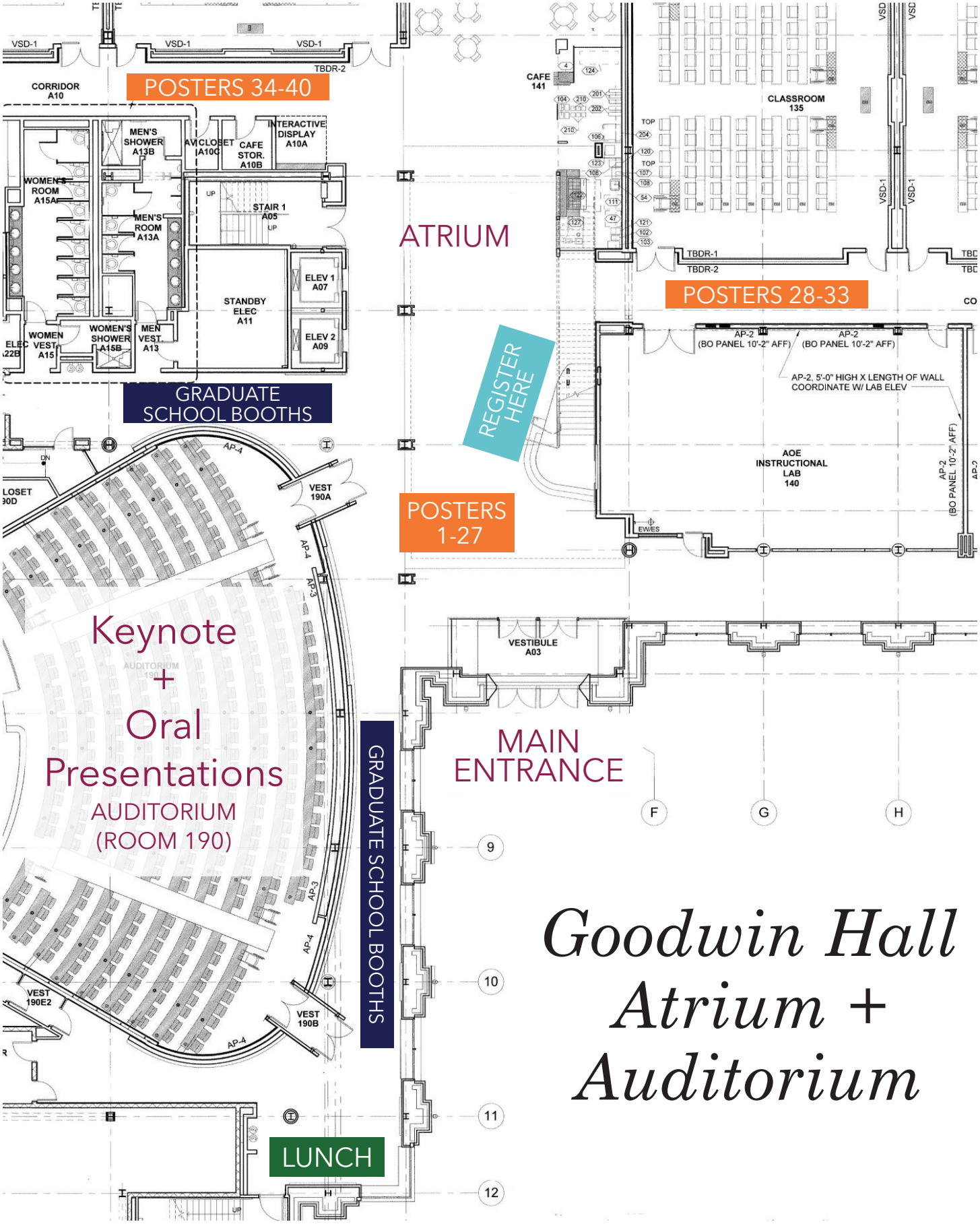
COLLEGE OF ENGINEERING

DEPARTMENT OF MECHANICAL ENGINEERING

DEPARTMENT OF PHYSICS

MASTER OF PUBLIC HEALTH

TRANSLATIONAL BIOLOGY, MEDICINE, + HEALTH



Goodwin Hall Atrium + Auditorium

Contents

Poster Presentations
Session 1 9:30AM - 10:30AM

1 **Veronica Able-Thomas** *(Hollins University, Chemistry)*
Effect of Novel Connexin43 Mimetic Peptide on Microtubule Dynamics in Glioma Stem Cells
VTCRI MOLECULAR VISUALIZATION SURF

2 **Linda Allworth** *(Virginia Tech, Chemistry)*
Bioinformatic and Network Analysis of Trimeric Autotransporters in Fusobacterium nucleatum
FRALIN SUMMER UNDERGRADUATE RESEARCH FELLOWSHIP

3 **Courtney Amos** *(Virginia Tech, Human Nutrition, Foods, and Exercise)*
Do Personal Characteristics have an effect on Cooperative Extension agent willingness to participate in an interview on Intervention Dissemination
TRANSLATIONAL OBESITY UNDERGRADUATE RESEARCH SCHOLARS

4 **Claudia Atwood** *(Virginia Tech, Biochemistry)*
Isolation and Characterization of Terpenoid Metabolizing Microbes in the Switchgrass (Panicum virgatum L.) Root Endosphere
FRALIN SUMMER UNDERGRADUATE RESEARCH FELLOWSHIP

5 **Katelee Averett** *(New River Community College, Biological Sciences; AA)*
Effects of Forcefully Removing Water from the Ear Canal
VIRGINIA TECH-VIRGINIA COMMUNITY COLLEGE SYSTEM BRIDGES TO THE BACCALAUREATE PROGRAM

6 **Haley Bain** *(Virginia Tech, Chemical Engineering)*
Homo-oligomerization in X-linked intellectual disability associated CASK mis-sense mutation
VTCRI *neuro*SURF

7 **Chris Barnes** *(William Fleming High (teacher), Biology, Chemistry)*
Evaluating the use of chemical deposition for light-based dielectrophoresis
RET: BIOMECHANICS FROM MOLECULAR TO ORGANISMAL SCALES

8 **Elizabeth Barton** *(Virginia Tech, Biochemistry)*
Understanding the Possible Role of Plant Cornichon Proteins in Brome Mosaic Virus
FRALIN SUMMER UNDERGRADUATE RESEARCH FELLOWSHIP

9 **John Bowman** *(Virginia Tech, Electrical Engineering)*
Analysis of AAL-PIP Battery Health Over Time
SPACE @ VT

10 **Aaron Brock** *(Virginia Tech, Microbiology)*
Ascertaining the role of the che2 operon in Sinorhizobium meliloti using bacterial two-hybrid screening
MULTICULTURAL ACADEMIC OPPORTUNITIES PROGRAM (MAOP)

Poster Presentations
Session 1 (continued)

11 **Rebecca Button** *(Commonwealth Governor's School, Currently in High school)*
3D Engineering of Synthetic Tumors
INDEPENDENT RESEARCH

12 **Eileen Cahill** *(Georgetown University, Biology)*
Occurrence of emerging contaminants in an urban storm water network due to impacts of sewer system exfiltration
NSF/REU SITE: INTERDISCIPLINARY WATER SCIENCE AND ENGINEERING

13 **Chelsea Cereghino** *(Virginia Tech, Microbiology)*
Diverse and dynamic bacterial communities inhabit root nodules of soybean
INDEPENDENT RESEARCH

14 **Sydney Charles** *(Southwest Virginia Community College, Nutrition)*
Do Neanderthal-specific SNP's promote obesity?
VIRGINIA TECH-VIRGINIA COMMUNITY COLLEGE SYSTEM BRIDGES TO THE BACCALAUREATE PROGRAM

15 **Leeciling Chea** *(Virginia Tech, Computer Science)*
Revitalizing the LEWAS Interactive Display for Education
INDEPENDENT RESEARCH

16 **Nala Chehade *et al.*** *(Virginia Tech, International Studies)*
Refugee Summer Lab
GLOBAL FORUM UNDERGRADUATE SUMMER RESEARCH LAB

17 **James Cole** *(The College of William and Mary, Neuroscience)*
Perineuronal net formation has region specificity and is regulated by neuronal activity in mouse LGN
VTCRI *neuro*SURF

18 **Michael Collver**
(Blacksburg High School (teacher), Technology of Robotic Design and Manufacturing Systems)
Using additive manufacturing and off-the-shelf electronic hardware to develop a bimodal payload dispersal platform inspired by the autorotation observed in maple seeds.
RET: BIOMECHANICS FROM MOLECULAR TO ORGANISMAL SCALES

19 **Alexandria Cook *et al.*** *(Milwaukee School of Engineering, BioMolecular Engineering)*
Antibiotic Resistance in Wastewater Treatment Plants in Chennai, India
NSF/REU SITE: INTERDISCIPLINARY WATER SCIENCE AND ENGINEERING

20 **Allison Coomber** *(Cornell University, Plant Science)*
The Relationship Between Brown Marmorated Stink Bug and Fusarium spp.
VT'S RESEARCH AND EXTENSION EXPERIENTIAL LEARNING: SECURING OUR FOOD

Poster Presentations Session 1 (continued)

21 **Caitlin Donahue** *(Roanoke College, Biochemistry)*
Protein 4.1G interacts directly with presynaptic adhesion molecule neurexin
VTCRI MOLECULAR VISUALIZATION SURF

22 **Amanda Donaldson** *(Humboldt State University, Forestry)*
Investigation of the Dimensions, Distribution and Abundance of Macropores Throughout Virginia
NSF/REU SITE: INTERDISCIPLINARY WATER SCIENCE AND ENGINEERING

23 **George Edwards** *(Virginia Tech, Experimental Neuroscience)*
Does repeated Mild Traumatic Brain Injury/Concussion affect neuronal survival in areas with loss of astrocyte function?
VTCRI *neuro*SURF

24 **Harald Ellorin** *(Tidewater Community College, Horticulture)*
Examining the biocontrol ability of rain-derived bacteria
VT'S RESEARCH AND EXTENSION EXPERIENTIAL LEARNING: SECURING OUR FOOD

25 **Matthew Emanuel** *(Virginia Tech, Matthew Emanuel)*
Body and Soul: Assessing the effects of putative TH disruptors on body growth and schooling behavior in Xenopus laevis tadpoles
VIRGINIA TECH-VIRGINIA COMMUNITY COLLEGE SYSTEM BRIDGES TO THE BACCALAUREATE PROGRAM

26 **Ravin Fisher** *(Hampton University, Biology (Cellular & Molecular))*
Investigating the effect of connexin43 on adenoviral replication center maturation
VTCRI MOLECULAR VISUALIZATION SURF

27 **Taylor Flynn** *(Virginia Tech, Clinical Neuroscience)*
Predictive Validity Across Measures of Anxiety-Like Behavior in Animal Models
INDEPENDENT RESEARCHER

28 **Momina Khan** *(Virginia Tech, Human Nutrition, Foods and Exercise)*
Atrial Fibrillation Associated with Perinexal Expansion
VTCRI MOLECULAR VISUALIZATION SURF

29 **Taylor Lear** *(Virginia Tech, Biological Sciences)*
Antibiotic Resistance in Wastewater Treatment Plants in Chennai, India
VTCRI *neuro*SURF

30 **Samantha Leigh** *(Christopher Newport University, Neuroscience)*
Differing Levels of Upper-Extremity Constraint on Emerging Behaviors in Infants with Hemiparetic Cerebral Palsy
VTCRI *neuro*SURF

Poster Presentations Session 1 (continued)

31 **Gabrielle Lewis** *(Hollins University, Biology)*
Protein-protein interaction between Connexin 43 and PIK3CB/p110ë_ in glioblastoma cells
VTCRI *neuro*SURF

32 **Doug Murray** *(Virginia Tech, Biological Sciences)*
Altered translation initiation limits gap junction formation during epithelial-mesenchymal transition
VTCRI MOLECULAR VISUALIZATION SURF

33 **Ryan Nasser** *(Virginia Tech, Neuroscience)*
Reduction of VAChT expression has no significant impact on the NMJ
VTCRI *neuro*SURF

34 **Katherine Pereira** *(Virginia Tech, Clinical Neuroscience)*
Investigating the Role of QSOX1 in Skeletal Muscles and their Synapses
VTCRI *neuro*SURF

35 **Kian Simpson** *(Harvard University, Neurobiology)*
Trust in economic exchange for individuals with borderline personality disorder
VTCRI *neuro*SURF

36 **Carleigh Studtmann** *(Bridgewater College, Biochemistry)*
IImmunohistochemical Analysis of Visual Cortex in Control Rats and Rats with Mild Traumatic Brain Injury
VTCRI *neuro*SURF

37 **Joseph Teamer** *(Virginia State University, Biology/Mathematics)*
Early Identification Program Toxoplasma gondii-induced activated microglia cells contribute to the hippocampal inhibition of axosomatic synapses
VTCRI *neuro*SURF

38 **Jonathan Van Name** *(College of William and Mary, Neuroscience)*
The role of complex retinogeniculate synapses in mouse visual behavior
VTCRI *neuro*SURF

39 **Alicia Yu-Shan** *(Virginia Tech, Microbiology)*
Investigating Ikaros zinc finger transcription factor protein complexes by super resolution localization microscopy
VTCRI MOLECULAR VISUALIZATION SURF

40 **Tiffany Fabian** *(Northern Virginia Community College, Psychology)*
Differing Levels of Upper-Extremity Constraint on Emerging Behaviors in Infants with Hemiparetic Cerebral Palsy
MULTICULTURAL ACADEMIC OPPORTUNITIES PROGRAM (MAOP)

Oral Presentations
Session 1 10:40AM-12:00PM

MODERATED BY: **Julia Byrd** *Graduate Student in Civil &Environmental Engineering*

10:45-11:00

Grace Davis

(Virginia Tech, HNFE)

Comparing Mitochondrial Targeted Peptides and Idebenone on Complex III of the Electron Transport Chain in Damaged Mitochondria

TRANSLATIONAL OBESITY UNDERGRADUATE RESEARCH SCHOLARS

11:00-11:15

Joshua Feazell

(Virginia Tech, Biology)

Distribution of Connexin 40 and NaV1.5 in the Atria

VTCRI MOLECULAR VISUALIZATION SURF

11:15-11:30

Philip Hernandez

(William Fleming High School (teacher), Biology, AP Biology)

Tongue-stick: Novel method of tongue-flick in Chrysopelea paradisi during gap-bridging

RET: BIOMECHANICS FROM MOLECULAR TO ORGANISMAL SCALES

11:30-11:45

Kathryn Lopez

(Florida State University, Chemical Engineering)

Chemical Reduction of Geosmin Concentrations in River Water Using EarthTec®

NSF/REU SITE: INTERDISCIPLINARY WATER SCIENCE AND ENGINEERING

11:45-12:00

Dillon Shapiro

(Virginia Tech, Neuroscience)

Characterizing the effect of FGFBP1 on the activity of FGF's in muscle development and regeneration

VTCRI *neuro*SURF

Poster Presentations
Session 2 1:00PM - 2:00PM

1 **David Barto** *(Virginia Tech, Biochemistry)*
Molecular Modeling of Amyloid Aggregation
INDEPENDENT RESEARCH

2 **Nicole Eng** *(Lafayette College, Biology)*
Investigating the role of an uncharacterized bacterial protein during infection of Agrobacterium sp. H13-3 by phage 7-7-1.
MULTICULTURAL ACADEMIC OPPORTUNITIES PROGRAM (MAOP)

3 **Mark England** *(Hurley High School (teacher), Biology)*
Biaxial Tensile Properties of Peyronie's Disease Tissues
RET: BIOMECHANICS FROM MOLECULAR TO ORGANISMAL SCALES

4 **Daniel Fathalikhani** *(Virginia Tech, HNFE)*
C57BL/6J mice have an inherent energy capacity for running wheel endurance exercise
FRALIN SUMMER UNDERGRADUATE RESEARCH FELLOWSHIP

5 **Leah Finegold** *(Oberlin College, Environmental Studies)*
Epilimnetic mixing events exacerbate methane ebullition flux in a small eutrophic drinking water reservoir
NSF/REU SITE: INTERDISCIPLINARY WATER SCIENCE AND ENGINEERING

6 **Taylor Flynn** *(Virginia Tech, Clinical Neuroscience)*
Validation of Emotional Avatars
INDEPENDENT RESEARCH

7 **Gary Fortemberry** *(GMU, Biology/Chemistry dual)*
Characterization of three human lung bronchial epithelial cell lines
VIRGINIA TECH-VIRGINIA COMMUNITY COLLEGE SYSTEM BRIDGES TO THE BACCALAUREATE PROGRAM

8 **Myiah Freeman** *(University of North Carolina Charlotte, Civil Engineering)*
Evaluation of Disparities in North Carolina Well Programs: The Role of Income
NSF/REU SITE: INTERDISCIPLINARY WATER SCIENCE AND ENGINEERING

9 **Sara Freix** *(Virginia Tech, Biological Systems Engineering)*
Crayfish Responses to Water Quality Parameters: A Case Study
INDEPENDENT RESEARCH

10 **Maja Gabrielson** *(Virginia Tech, Public and Urban Affairs, Urban Planning and Policy)*
Perceptions of Low-Income Residents about Multi-Modal Transportation Accessibility in Roanoke, Virginia
GLOBAL FORUM UNDERGRADUATE SUMMER RESEARCH LAB

Poster Presentations Session 2 (continued)

11 **Bruce Gidley** *(King's Fork High School (teacher), Technology Foundations)*
Agricultural Disease Spreading by Rain Drop Impact.
RET: BIOMECHANICS FROM MOLECULAR TO ORGANISMAL SCALES

12 **Rebecca Good** *(Virginia Tech, Landscape Architecture)*
The Impact of Demographic Differences on the Use of Roanoke City Public Parks
GLOBAL FORUM UNDERGRADUATE SUMMER RESEARCH LAB

13 **Jeroko Greene** *(Virginia Tech, Psychology)*
The moderating effect of effortful control on the association between parent-child relationship and internalizing symptomatology
VIRGINIA TECH-VIRGINIA COMMUNITY COLLEGE SYSTEM BRIDGES TO THE BACCALAUREATE PROGRAM

14 **Alexander Grimaudo** *(Virginia Tech, Wildlife Conservation)*
The effect of environmental conditions on night incubation behavior in wood ducks
FRALIN SUMMER UNDERGRADUATE RESEARCH FELLOWSHIP

15 **Monica Hackett** *(Spelman College, Health Science)*
Science communications: Using a Web-based Newsletter to Inform Scholars and Stakeholders About Science Education Programs at Virginia Tech
INDEPENDENT RESEARCH

16 **Dawn Hakkenberg** *(Patrick Henry High School (teacher), Algebra)*
Does lead exposure influence male attractiveness in zebra finches?
RET: BIOMECHANICS FROM MOLECULAR TO ORGANISMAL SCALES

17 **Logan Healy** *(Virginia Tech, Architecture)*
Analysis of the Sustainability and Infrastructural Restructuring of Former Open Pit Mines
INDEPENDENT RESEARCH (ACC CREATIVITY & INNOVATION)

18 **Joseph Hilger** *(Virginia Tech, Biological Sciences)*
FRALIN SUMMER UNDERGRADUATE RESEARCH FELLOWSHIP

19 **Laura Hogan** *(Hollins University, Interdisciplinary in Social Sciences with an emphasis in Elementary Education)*
Roanoke City Community Engagement
GLOBAL FORUM UNDERGRADUATE SUMMER RESEARCH LAB

20 **Jonathan Huaman** *(Virginia Tech, Clinical Neuroscience)*
Altered metabolic function in limbic brain of rodent model bred to display vulnerability to anxiety- and depression-like phenotype.
INDEPENDENT RESEARCH

Poster Presentations Session 2 (continued)

21 **Tiffany Hunter** *(Woodbridge High School (teacher), Biology)*
Investigating the effect of altered centromere stiffness on spindle pole separation in mitotic cells
RET: BIOMECHANICS FROM MOLECULAR TO ORGANISMAL SCALES

22 **Kelly Hurley** *(Virginia Tech, Biochemistry)*
Fighting Bacteria with Bacteria: Determining Effects of Biocontrol against Fire Blights on Apple Trees
INDEPENDENT RESEARCH

23 **Matthew Hyland** *(Virginia Tech, Neuroscience)*
The Effects of SSRI Exposure on the Domains of Depression-Like Behavior in Rats
INDEPENDENT RESEARCH (ENGELNOVITT UNDERGRADUATE RESEARCH FELLOWSHIP)

24 **John Jewell** *(Pulaski County High School (teacher), Math)*
Brain Buster: The Effect of TBI on Astrocyte Response
RET: BIOMECHANICS FROM MOLECULAR TO ORGANISMAL SCALES

25 **Shannen Kelly** *(Hollins University, Environmental Science)*
Survey of Photosynthetic Capacity of Sorghum halepense Along a Latitudinal Gradient
FRALIN SUMMER UNDERGRADUATE RESEARCH FELLOWSHIP

26 **Sarah Kim** *(Virginia Tech, Clinical Neuroscience)*
The metabolic activity of cytochrome c oxidase in the limbic system of adult rat models of depression
INDEPENDENT RESEARCH

27 **Man Jun Koh *et al.*** *(Virginia Tech, Aerospace Engineering)*
SSA (Space Situational Awareness) Research: Creating an Autonomous Satellite Tracking Telescope
SPACE @ VT

28 **Suzanne Laliberte** *(Virginia Tech, Biological Sciences)*
Petunia as a Model for Salt Tolerance
VT'S RESEARCH AND EXTENSION EXPERIENTIAL LEARNING: SECURING OUR FOOD

29 **Sophia Lee** *(Virginia Tech, Environmental Science: Water Science & Quality)*
Friend or Foe? Pseudomonas and its Colonization of Soybean Root Nodules Decreases Plant Growth
INDEPENDENT RESEARCH

30 **Ira Long III** *(Virginia Tech, Political Science)*
The State of Workforce Development in Roanoke City
GLOBAL FORUM UNDERGRADUATE SUMMER RESEARCH LAB

Poster Presentations Session 2 (continued)

31 **Nye Lott** *(Virginia Tech, Environmental Horticulture)*
From Poison Ivy Hairy Root Culture to the Appalachian Trail (and Back Again)
FRALIN SUMMER UNDERGRADUATE RESEARCH FELLOWSHIP

32 **Ryan Lupi** *(Virginia Tech, HNFE)*
Human satellite cell function is regulated by autocrine secretion of IL-6 and TNF-Î±
TRANSLATIONAL OBESITY UNDERGRADUATE RESEARCH SCHOLARS

33 **Sid Madhavan *et al.*** *(Virginia Tech, Neuroscience)*
Validation of Locomotor Activity as a Model of Chronic Nicotine Exposure
FRALIN SUMMER UNDERGRADUATE RESEARCH FELLOWSHIP

34 **Madison Mcelhinney** *(Hollins University, international Studies)*
Innovation Roanoke: Public and Private Sector Relationships
GLOBAL FORUM UNDERGRADUATE SUMMER RESEARCH LAB

35 **Hunter Moore** *(Virginia Tech, Clinical Neuroscience)*
Evaluating the microbiota's role in emotional behavior: antibiotic treatment exacerbates anxiety in high anxiety-prone rats
INDEPENDENT RESEARCH

36 **Cristina Nardini** *(The College of New Jersey, Psychology)*
The effect of lead exposure during the critical postnatal period on learning ability
MULTICULTURAL ACADEMIC OPPORTUNITIES PROGRAM (MAOP)

37 **Gabrielle Nelson** *(Tidewater Community College, Horticulture)*
Virus-induced gene silencing in cucumber and tobacco / Nutrient uptake comparisons in terrestrial and aquatic settings
VT'S RESEARCH AND EXTENSION EXPERIENTIAL LEARNING: SECURING OUR FOOD

38 **Kareem Omeish** *(Northern Virginia Community College NOVA, Psychology)*
Splice variant for Foxp2 and its impacts on vocalization and behavior of juvenile rats
VIRGINIA TECH-VIRGINIA COMMUNITY COLLEGE SYSTEM BRIDGES TO THE BACCALAUREATE PROGRAM

39 **Zachary Perkins** *(University of Virginia, Environmental Sciences)*
Examining Spatio-Temporal Dynamics of Streams Using a High-Frequency Water Quality Sensor
NSF/REU SITE: INTERDISCIPLINARY WATER SCIENCE AND ENGINEERING

40 **Sophia Pinton** *(Virginia Tech, Food Science and Technology)*
Investigating the Behavior of Parasitic and Pathogenic Organisms on Vegetables
VT'S RESEARCH AND EXTENSION EXPERIENTIAL LEARNING: SECURING OUR FOOD

Oral Presentations

Session 2 2:10-3:30PM

MODERATED BY: **Dr. Bryan Brown** *Assistant Professor of Biological Sciences*

2:15-2:30

Jodie Caldwell

(Lord Botetourt High School (teacher), Ecology, Human Anatomy and Physiology, Biology)

Community Composition of Benthic Macroinvertebrates and Water Quality Along a Sediment Gradient

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

2:30-2:45

Elaine Metz

(Hollins University, Biology)

Testing Naturally Occurring Verticillium Fungi for use as a Biological Control of the Invasive Tree-of-Heaven (Ailanthus altissima).

FRALIN SUMMER UNDERGRADUATE RESEARCH FELLOWSHIP

2:45-3:00

Sam Park

(Virginia Tech, Biochemistry)

Phosphorus Solubility and Uptake with Arabidopsis thaliana

VT'S RESEARCH AND EXTENSION EXPERIENTIAL LEARNING (VT-REEL) PROGRAM ON SECURING OUR FOOD

3:00-3:15

Robert Smith

(New River Community College, Chemistry, AA)

Investigating the Role of Guy1 in the Sex Determination Pathway of the Asian malaria mosquito Anopheles stephensi.

VIRGINIA TECH-VIRGINIA COMMUNITY COLLEGE SYSTEM BRIDGES TO THE BACCALAUREATE PROGRAM

3:15-3:30

Joanne Tang

(Virginia Tech, Mechanical Engineering)

Ear and Nose-Leaf Coordination in Roundleaf Bats (Hipposideros pratti) During Sonar Emission and Reception

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

Poster Presentations
Session 3 3:30PM - 4:30PM

1 **Carla Corvin** *(Christiansburg High School (teacher), Biology and Ecology)*
Enhancing Wastewater Reuse by Using Osmotic Membrane Photobioreactor (OMPBR)
WATERECUBEG (ENGINEERING, ECOLOGY, ENVIRONMENT, AND GEOSCIENCES)

2 **Katharine Davenport Davis**
(Blacksburg High School (teacher), Chemistry, Independent Student Research)
Translating Applied Aquatic Chemistry Research to Introductory High School Chemistry Coursework: Developing Methodology to Determine Copper Speciation
WATERECUBEG (ENGINEERING, ECOLOGY, ENVIRONMENT, AND GEOSCIENCES)

3 **Grace Davis** *(Virginia Tech, HNFE)*
Comparing Mitochondrial Targeted Peptides and Idebenone on Complex III of the Electron Transport Chain in Damaged Mitochondria
WATERECUBEG (ENGINEERING, ECOLOGY, ENVIRONMENT, AND GEOSCIENCES)

4 **Anna Delgado** *(William Fleming High School (teacher), Biology)*
How will benthic macroinvertebrate communities differ between specific areas of Stroubles Creek that have riparian coverage and those that lack coverage?
WATERECUBEG (ENGINEERING, ECOLOGY, ENVIRONMENT, AND GEOSCIENCES)

5 **Andrew Farley** *(Virginia Tech, Mechanical Engineering)*
Design and Creation of a Platform to Compare Sonar Echoes and Stereovision
US-CHINA COLLABORATION: BATS AS MODEL ORGANISMS FOR BIOINSPIRED ENGINEERING

6 **Karen Hicks** *(Glenvar High School (teacher), Chemistry)*
The Search for Microplastics in an Urban Stream
WATERECUBEG (ENGINEERING, ECOLOGY, ENVIRONMENT, AND GEOSCIENCES)

7 **Yangsoo Kim** *(Virginia Western Community College (teacher), physics)*
Designing an Auto Water Sampling Apparatus at LEWAS Lab
WATERECUBEG (ENGINEERING, ECOLOGY, ENVIRONMENT, AND GEOSCIENCES)

8 **Alicia Lowe**
(Franklin County High School (teacher), Biology, Ecology, AP Environmental Science)
Analysis of Nitrogen & Phosphorous in Soil & Water Influenced by Agricultural Practices
WATERECUBEG (ENGINEERING, ECOLOGY, ENVIRONMENT, AND GEOSCIENCES)

9 **Mark Madden** *(Cave Spring High School (teacher), AP/DE Biology)*
Interplay Between Disinfectants and Microbial Population in Two Simulated Reclaimed Water Distribution Systems
WATERECUBEG (ENGINEERING, ECOLOGY, ENVIRONMENT, AND GEOSCIENCES)

10 **Amar Mohanty** *(Virginia Tech, Mechanical Engineering)*
3D Reconstruction of the Biosonar Beampattern of the Great Roundleaf Bat (Hipposideros armiger)
US-CHINA COLLABORATION: BATS AS MODEL ORGANISMS FOR BIOINSPIRED ENGINEERING

Poster Presentations Session 3 (continued)

11 **Rachelle Rasco** *(Carroll County High School (teacher), STEM Lab Manager)*
Using Tracer Studies to Calculate the Dispersion Coefficient for Webb Branch
WATERECUBEG (ENGINEERING, ECOLOGY, ENVIRONMENT, AND GEOSCIENCES) RET

12 **Sam Rauf** *(Roanoke College, Economics)*
Public vs. Private Perceptions about Economic and Community Development in Roanoke, VA
GLOBAL FORUM UNDERGRADUATE SUMMER RESEARCH LAB

13 **Cole Reeves** *(Virginia Tech, Fish Conservation)*
Big Stony Creek Brown Trout Diet Pilot Study
FRALIN SUMMER UNDERGRADUATE RESEARCH FELLOWSHIP

14 **Luis Santos** *(Florida State University, Biology)*
The Effect of Foliar Chemicals On Two New Blackberry Cultivars: An Analysis of Leaf Metabolites, Fruit Quality, Fruit Yield, and Consumer Appeal
VT'S RESEARCH AND EXTENSION EXPERIENTIAL LEARNING: SECURING OUR FOOD

15 **Hannah Sawyer** *(Virginia State University, Agriculture)*
Effects of Rhizobacteria on Root Terpenoids in Switchgrass / Cover Crop Systems and Tilling Effects on Insect Pest and Predator Populations
VT'S RESEARCH AND EXTENSION EXPERIENTIAL LEARNING: SECURING OUR FOOD

16 **Brittney Shaw** *(Bowie High School (teacher), Biology, Microbiology, Anatomy and Physiology)*
Changes in Limb Symmetry During Two and Four Mile Runs
RET: BIOMECHANICS FROM MOLECULAR TO ORGANISMAL SCALES

17 **Michael Sherburne** *(Virginia Tech, Electrical Engineer)*
State-of-the-Art Solid-State Switch Feasibility Analysis for Pulsed Power Linear Transformer Driver Applications
SPACE @ VT

18 **Wenting Shi *et al.*** *(Virginia Tech, Chemical Engineering)*
Controlled Drug Delivery System
INDEPENDENT RESEARCH

19 **Nitika Sood** *(Pulaski County High (teacher), Algebra 2)*
Measuring variation in stiffness of insect tracheal tubes using atomic force microscopy.
RET: BIOMECHANICS FROM MOLECULAR TO ORGANISMAL SCALES

20 **Laura Stange** *(Virginia Tech, Environmental Horticulture)*
Wildflower Establishment and Pollinator Populations in Virginia
FRALIN SUMMER UNDERGRADUATE RESEARCH FELLOWSHIP

Poster Presentations Session 3 (continued)

21 **Tristan Stoyanof** *(Virginia Tech, Biological Sciences)*
Chemoreceptor McpS and its Affinity for Specific Ligands
INDEPENDENT RESEARCH

22 **Muneeza Syed** *(George Mason University, Chemistry/Biochem and Pharmaceuticals)*
Rhodamine Release from Tailored Polymer Nanoparticles
VIRGINIA TECH-VIRGINIA COMMUNITY COLLEGE SYSTEM BRIDGES TO THE BACCALAUREATE PROGRAM

23 **Brandi Thomas** *(Southwest Virginia Community College, Microbiology)*
Generating a Chromosomal Gene Deletion of ompC in the Phytopathogen Pantoea stewartii
VIRGINIA TECH-VIRGINIA COMMUNITY COLLEGE SYSTEM BRIDGES TO THE BACCALAUREATE PROGRAM

24 **Renee Thompson** *(Bowie High School (teacher), Biology, Integrated Science)*
Protein Activated Rubber Curing
RET: BIOMECHANICS FROM MOLECULAR TO ORGANISMAL SCALES

25 **Natalie Tobias** *(Virginia Tech, Industrial Design)*
Study of accessibility barriers to mobility-impaired persons in Roanoke, VA
GLOBAL FORUM UNDERGRADUATE SUMMER RESEARCH LAB

26 **Alexandra Toloczko** *(Virginia Tech, Chemical Engineering and Neuroscience)*
The Prevention of Non-Resolving Inflammation & Restoration of Monocyte Homeostasis
FRALIN SUMMER UNDERGRADUATE RESEARCH FELLOWSHIP

27 **Leslie Uptegraff** *(Virginia Tech, Environmental Policy and Planning)*
Travel Behavior and Preferences Among Healthcare Workers in Roanoke's Innovation Corridor
GLOBAL FORUM UNDERGRADUATE SUMMER RESEARCH LAB

28 **Michael Valosin** *(Virginia Tech, Aerospace Engineering)*
Flight Mechanics of Bats Drinking on the Wing
US-CHINA COLLABORATION: BATS AS MODEL ORGANISMS FOR BIOINSPIRED ENGINEERING

29 **Schuyler van Montfrans *et al.*** *(William Fleming High School (teacher), Ecology, Biology)*
The effects of incubation temperature on exploratory and feeding behavior in wood duck ducklings
RET: BIOMECHANICS FROM MOLECULAR TO ORGANISMAL SCALES

30 **Viktor Wahlquist** *(Binghamton University, Electrical Engineering)*
Design of an Educational Virtual Environment: Effects of a Storm Event on a Small Urban Stream
NSF/REU SITE: INTERDISCIPLINARY WATER SCIENCE AND ENGINEERING

Poster Presentations
Session 3 (continued)

31 **Holly Waterman** *(Virginia Tech, Landscape Architecture)*
Improving Connectivity and Engaging the Public in the Roanoke Innovation Corridor
GLOBAL FORUM UNDERGRADUATE SUMMER RESEARCH LAB

32 **Mindy Wei** *(University of Virginia, Biology)*
Does one size fit â€œall?â€ù: Exploration of the magnitude of effect of a statewide physical activity in white vs nonwhite populations
TRANSLATIONAL OBESITY UNDERGRADUATE RESEARCH SCHOLARS

33 **Christian White** *(Yale University, Mechanical Engineering)*
Nutrient Recovery from Wastewater Using a Bioelectrochemical System
NSF/REU SITE: INTERDISCIPLINARY WATER SCIENCE AND ENGINEERING

34 **Sedona Whitmore** *(Virginia Tech, Psychology)*
Parent-Child Conversations and Childrenâ€™s Healthy Snack Choices
FRALIN SUMMER UNDERGRADUATE RESEARCH FELLOWSHIP

35 **Peter Windes** *(Virginia Tech, Mechanical Engineering)*
3D Motion Capture of Bat Flight Maneuvers
US-CHINA COLLABORATION: BATS AS MODEL ORGANISMS FOR BIOINSPIRED ENGINEERING

36 **Jason Worley** *(Patrick Henry Community College (teacher), Biology)*
Iron & Manganese Oxidation Cycles in a Local Drinking Reservoir
WATERECUBEG (ENGINEERING, ECOLOGY, ENVIRONMENT, AND GEOSCIENCES) RET

37 **Alexandria Wright** *(Virginia Tech, HNFE- DIET)*
A genetic basis for motivated exercise
TRANSLATIONAL OBESITY UNDERGRADUATE RESEARCH SCHOLARS

38 **Nan Yang** *(Virginia Tech, Human Nutrition, Food, and Exercise)*
Excess nutrient niche negatively impacts muscle stem cell homeostasis
TRANSLATIONAL OBESITY UNDERGRADUATE RESEARCH SCHOLARS

39 **Kristine Yarnoff** *(Virginia Tech, Biological Sciences)*
Understanding the Role of PilB in Motility and Biofilms as a c-di-GMP Receptor
FRALIN SUMMER UNDERGRADUATE RESEARCH FELLOWSHIP

40 **Hisyam Mohsin** *(Virginia Tech, Civil & Environmental Engineering)*
Effect of Road Salt on the Lead Level in Plumbing System
INDEPENDENT RESEARCH

Abstracts

Fralin Summer Undergraduate Research Fellowship

PROGRAM DESCRIPTION

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 six 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.

The Global Change Center at Virginia Tech and Hollins University recently developed a unique undergraduate training and graduate student recruitment model. The program, led by Dr. Bill Hopkins, provides summer research experiences at Virginia Tech for select Hollins undergraduate students, with the explicit goal of identifying possible mentor-mentee connections/relationships for their future graduate training. This model was piloted this summer on a small scale as part of the Fralin SURF program, with the intent of scaling-up the initiative in future years.

PROGRAM COORDINATOR

Keri Swaby, Coordinator of the Office of Undergraduate Research

PROGRAM PARTICIPANTS

Linda Allworth

VIRGINIA TECH, *Chemistry*
Faculty Mentor: Dr. Daniel Slade

Claudia Atwood

VIRGINIA TECH, *Biochemistry*
Faculty Mentor: Dr. Dorothea Tholl

Elizabeth Barton

VIRGINIA TECH, *Biochemistry*
Faculty Mentor: Dr. Xiaofeng Wang

Daniel Fathalikhani

VIRGINIA TECH, *HNFE*
Faculty Mentor: Dr. Robert GrangeWang

Alexander Grimaudo

VIRGINIA TECH, *Wildlife Conservation*
Faculty Mentor: Dr. William Hopkins

Joseph Hilger

VIRGINIA TECH, *Biological Sciences*
Faculty Mentor: Dr. Birgit Scharf

Fralin Summer Undergraduate Research Fellowship

PROGRAM PARTICIPANTS *continued*

Shannen Kelly
HOLLINS UNIVERSITY, *Environmental Science*
Faculty Mentor: Dr. Jacob Barney

Nye Lott
VIRGINIA TECH, *Environmental Horticulture*
Faculty Mentor: Dr. John Jelesko

Sid Madhavan
VIRGINIA TECH, *Neuroscience*
Faculty Mentor: Dr. Matthew Buczynski

Elaine Metz
HOLLINS UNIVERSITY, *Biology*
Faculty Mentor: Dr. Scott Salom

Cole Reeves
VIRGINIA TECH, *Fish Conservation*
Faculty Mentor: Dr. Kathryn McBaine

Laura Stange
VIRGINIA TECH, *Human Nutrition, Foods, & Exercise*
Faculty Mentor: Dr. Megan O'Rourke

Alexandra Toloczko
VIRGINIA TECH, *Chemical Engineering & Neuroscience*
Faculty Mentor: Dr. John Jelesko

Sedona Whitmore
VIRGINIA TECH, *Psychology*
Faculty Mentor: Dr. Julie Dunsmore

Kristine Yarnoff
VIRGINIA TECH, *Biological Sciences*
Faculty Mentor: Dr. Zhaomin Yang

LINDA ALLWORTH VIRGINIA TECH / CHEMISTRY

Bioinformatic and Network Analysis of Trimeric Autotransporters in Fusobacterium nucleatum

Initially discovered in the mouth as a pathogenic oral bacterium, Fusobacterium is a known factor in various human infections such as Crohn's disease, ulcerative colitis, and preterm birth. Fusobacterium is also overrepresented in the tumors of patients with colorectal cancer. Little is known about its mechanism of invasion, particularly which outer membrane and secreted proteins are critical for Fusobacterium to enter into host cells during infection. Given that Fusobacteria lack Type I, II, III, IV, and VI protein secretion pathways, this investigation focused on Type V, specifically Type Vc trimeric autotransporter proteins. Trimeric autotransporters are known for their adhesive activity, and have previously been linked to invasive ability and virulence. In this study, Hidden Markov Models (HMMs) were used to screen Fusobacterium genomes for potential Type Vc proteins. Cytoscape was then applied to visualize the resulting data networks. Through this process, novel insight was gained regarding differences in sequence length, sequence similarity, and conserved domains for identified proteins across 20 strains of Fusobacteria. Additionally, initial observations about dissimilarities between passive and active invader strains were made. This provides a strong foundation for future work expressing, purifying, and experimentally characterizing the identified proteins of interest.

Mentor(s): Dr. Daniel Slade (Virginia Tech; Biochemistry)

CLAUDIA ATWOOD VIRGINIA TECH / BIOCHEMISTRY

Isolation and Characterization of Terpenoid Metabolizing Microbes in the Switchgrass (Panicum virgatum L.) Root Endosphere

Certain plant-associated microbes play an important role in plant growth, nutrient acquisition and tolerance to abiotic stressors. However, not much is known about how the plant can contribute to the establishment and maintenance of the its own microbiome. It has been found that microbial diversity and density is distinct between the different tissues of plants, suggesting there are specific mechanisms of microbial selection in each of the areas of the plant. Plant derived volatile organic compounds, like terpenoids, act as selective filters for microbes in the plant and therefore contribute to the management of the microbiome. High levels of the terpenoid borneol and its derivative camphor are found in switchgrass roots and have antimicrobial effects. It is hypothesized that that these compounds act as a filter by providing a carbon-source that only certain microbes can metabolize. Terpenoid-metabolizing microbes were isolated and identified from samples of switchgrass roots by enriching them in a selective media culture, with camphor or borneol being the only carbon source available to the apparent microbes present inside the root. After selection, isolates were characterized using Sanger sequencing. Preliminary results from sequencing microbial isolates early in the selection process show several terpenoid-degrading species (Brevundimonas sp., Sphingomonas sp.,) and terpenoid-tolerant species (rhizobium sp., microbacterium sp.,). Isolates identified after the full selection period will be characterized using this process as well. This information will provide fundamental evidence for the role of terpenoids in the establishment and maintenance of microbial communities in plant roots.

Mentor(s): Dr. Dorothea Tholl (Virginia Tech; Biological Sciences)

ELIZABETH BARTON VIRGINIA TECH / BIOCHEMISTRY

Understanding the Possible Role of Plant Cornichon Proteins in Brome Mosaic Virus

Positive-strand RNA viruses make up more than 30% of all virus genera, including human viruses, such as hepatitis C virus (HCV), Zika virus, dengue virus (DENV), along with numerous plant viruses. With a small RNA genome, they require host factors (proteins and lipids) to complete their genomic replication and life cycle. For instance, they assemble their viral replication complexes (VRCs) by recruiting host proteins and remodeling host intracellular membranes. Brome mosaic virus (BMV) is a well-studied model for positive-strand RNA viruses. It has recently been shown that BMV requires host Erv14 (ER vesicle 14 kD), a component of the coat protein complex II (COPII) in protein trafficking, for its replication in yeast. The deletion of the ERV14 gene in yeast inhibits BMV RNA replication significantly. Cornichon proteins are the homologs of Erv14 in plants, and the involvement of CNIHs (Cornichon Homologs) in BMVÃ¢â‚¬â„¢s natural infection is still unknown. In this project, I knocked down the expression of CNIHs of Nicotiana benthamiana (NbCHIN) and investigated the possible roles of Cornichon proteins in BMV replication in plant. Utilizing northern blotting, I quantified the amount of BMV-specific RNAs, which reflects the levels of BMV genomic replication. BMV RNA levels reduced in Nicotiana plants with reduced expression of NbCHINs in comparison to the untreated plants. The data suggested that the NbCHIN expression level was critical to BMV replication in plants and viral replication can be controlled by the manipulation of CHINs.

Mentor(s): Dr. Xiaofeng Wang (Virginia Tech; Plant, Pathology, & Weed Science)

DANIEL FATHALIKHANI VIRGINIA TECH / HUMAN NUTRITION, FOODS, & EXCERCISE

C57BL/6J Mice have an Inherent Energy Capacity for Running Wheel Endurance Exercise

In this study, we tested the hypothesis that improvement in mice running performance may be independent of adaptation in metabolic energy systems (e.g., mitochondrial enzymes). C57BL/6J male mice (age: 10 wks) were divided into two groups: runners (n=6) and non-runners (n=6). The 6 best runners among all the mice were selected after a 3- day trial period of wheel running; the remaining 6 mice were each housed in a cage with a locked wheel. All mice had access to food and water ad libitum. Over the 4 wk training period, runners averaged 7.1 Ã‚Â± 1.8 km per night. Body composition and in-vivo ankle plantar flexor torque-frequency, torque-velocity and fatigue contractile properties were assessed pre and post training. Post body composition revealed decreased %body fat (21%; p<0.05) but unchanged %lean mass in runners vs non-runners, while in vivo contractile properties were not different pre/post training or between groups. At sacrifice, although adaptation was expected, cardiac mitochondrial respiration was not different between the groups. In-vitro soleus force-frequency and power profiles between runners vs non-runners were increased 26% and 39% respectively (p<0.05). Soleus, and deep portions of gastrocnemius and quadriceps are Ã¢â‚¬Å"redÃ¢â‚¬ muscles active during running. Nevertheless, metabolic enzyme activities in these muscles were unchanged (e.g., Citrate synthase, Cytochrome C oxidase). These data suggest that despite physiological improvements (i.e., running ~7 km/night; soleus power), C57BL/6J mice have an inherent cardiac and skeletal muscle metabolic energy capacity that doesnÃ¢â‚¬â„¢t require adaptation in enzyme activity. One potential explanation is mitochondrial content is increased.

Mentor(s): Dr. Robert Grange (Virginia Tech; Human Nutrition, Foods, & Excercise)

ALEXANDER GRIMAUDO VIRGINIA TECH / WILDLIFE CONSERVATION

The effect of environmental conditions on night incubation behavior in wood ducks

Parental care, while costly to the parent, is essential for offspring development in many animals. In egg-laying species, incubation is a crucial aspect of parental care, and differences in egg temperature affect the physiology, morphology, behavior, and the survival of offspring. In birds, parental behavior regulates incubation, and thus, can be influenced by environmental changes. An understudied aspect of incubation is night incubation, where parents only incubate during the nights preceding the start of full (day and night) incubation. This behavior leads to lower eggshell microbial densities, shorter incubation periods, and greater hatch success. However, it is unknown whether parental condition or environmental conditions, such as ambient temperature, influence this behavior. We installed temperature loggers in wood duck nest boxes (n = 31 nests) that recorded both the ambient temperature and the temperature of the eggs, and we captured and weighed each incubating hen. Then, we examined the behavior of females during night incubation using the temperature data (i.e., increase/decrease in temperature indicates that the female is on/off nest). We found that egg temperature during night incubation was positively correlated with ambient temperature , and that female body mass was positively correlated with the total number of nights that the hen engaged in night incubation . This suggests that changes in weather or food availability may affect this important parental behavior. Thus, this study has implications for how climate change and human alterations to the environment may affect wildlife populations.

Mentor(s): Dr. William Hopkins (Virginia Tech; Fish & Wildlife Conservation), Sydney Hope (Virginia Tech; Fish & Wildlife Conservation)

JOSEPH HILGER VIRGINIA TECH / BIOLOGICAL SCIENCES

Quantifying the Expression of Chemotaxis Related Genes in Salmonella enterica serovar Typhimurium VNP20009, a strain engineered to target tumors

The use of bacteria as a form of cancer therapy has been of interest dating back to the late 19th century. One species has gained much attention, Salmonella enterica serovar Typhimurium, specifically strain VNP20009. This strain was constructed from wild type 14028 by deleting msbB causing the strain to be attenuated. VNP20009 is able to accumulate in tumors at a ratio 1,000 times higher than in healthy tissue such as the liver. However, the strain has had difficulty proving its effectiveness in Phase 1 Clinical Trials. One possible reason for this is its lack of chemotaxis, caused by a non-synonymous single nucleotide polymorphism in cheY. RNA sequencing was performed to determine the gene expression differences between VNP20009 and the parent strain 14028 under growth conditions favoring bacterial motility and chemotaxis. The differences found in the motility and chemotaxis master regulon differ by 2 fold according to RNAseq data. Our goal is to validate this data using quantitative Real Time PCR (qRT-PCR). Total RNA was isolated, and qRT-PCR was performed with SYBR Green I. It is expected that the che operon will show consistently lower expression in VNP20009 compared to 14028, the control strain, which follows with the decreased chemotactic response of the strain. In future studies, we will analyze the cause of these transcription level differences in the complex genetic hierarchy controlling bacterial motility and chemotaxis. We will also explore how these differences in bacterial gene expression affect the efficacy of its introduction to the patient.

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

SHANNEN KELLY HOLLINS UNIVERSITY / ENVIRONMENTAL SCIENCE

Survey of Photosynthetic Capacity of Sorghum halepense Along a Latitudinal Gradient

Invasive species cause broad ecological and economic damage worldwide. Previous studies have provided strong evidence that invasive species have the ability to adapt to varying climatic and environmental conditions along latitudinal gradients; however, while many studies have looked at growth and life history traits, few have investigated adaption at the physiological level. In this study, I investigated the photosynthetic characteristics of the grass species, Sorghum halepense (Johnsongrass). S. halepense is a rhizomatous species of Mediterranean origin that has a range from 55° N to 45° S in latitude worldwide. Its ability to be successful along such a severe latitudinal and climatic gradient raises questions about the plasticity of the individuals. While some speculate that expansion edges may be determined by temperature, it is possible that there are physiological factors that allow populations to be more successful at mid-range latitudes. In this study, the possibility that genetic variation is related to climate and latitude of a population's origin, potentially affecting the success of the population, was examined. Using the gas exchange system, LI-COR 6400XT, I measured the photosynthetic response to varying light intensities in six geographically distinct populations of S. halepense. Light response curves were constructed to observe differences in genic potential. It was determined that general trends relating to population and maximum photosynthetic capability existed, furthering the speculation that genetic adaptation has occurred across populations in response to differential selective pressures and stresses along the climate gradient.

Mentor(s): Dr. Jacob Barney (Virginia Tech; Plant Pathology, Physiology, & Weed Science)

NYE LOTT VIRGINIA TECH / ENVIRONMENTAL HORTICULTURE

From Poison Ivy Hairy Root Culture to the Appalachian Trail (and Back Again)

Poison Ivy is best known for its for causing allergenic dermatitis. Its sap contains urushiol, the natural chemical responsible for "poison ivy rash." The urushiol biosynthetic pathway is still quite speculative, though the Jelesko Lab has identified several biosynthetic gene candidates. The validation of these genes will require a Poison Ivy plant transformation and regeneration system. To this end, hairy root culture is a technique that uses Agrobacterium rhizogenes to genetically transform plant cells into permanent root cultures. Etiolated poison ivy hypocotyls were inoculated with two strains of A. rhizogenes, resulting in many initial hairy root cultures per plant. However, long term survival rates of independent hairy root cultures were low. To determine if stable transgenic poison ivy hairy root lines could be produced, A. rhizogenes harboring a Ti-binary plasmid with either a Firefly luciferase LUC or LUCINT gene were used to successfully create luciferase containing, bioluminescent hairy roots. These results demonstrate the feasibility of creating transgenic hairy roots, and is the first step towards using genome editing technologies to identify urushiol biosynthetic genes. Poison Ivy's preferred habitat is also largely unknown. Using the white blazes of the Appalachian Trail as an unbiased sampling technique, one can map both GPS coordinates and Poison Ivy presence or absence. I collected these data along a 21 mile stretch of the AT. Poison Ivy was not evenly distributed across this transect, suggesting specific geographical and climatic features define Poison Ivy's preferred habitat.

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

SID MADHAVAN VIRGINIA TECH / NEUROSCIENCE
IAN LEVINE VIRGINIA TECH / NEUROSCIENCE

Validation of Locomotor Activity as a Model of Chronic Nicotine Exposure

Tobacco use remains the single largest preventable cause of death in the world, and cigarette smoke kills nearly 500,000 people per year in the United States. Nicotine addiction is a complex disorder that results from drug-induced changes in brain signaling alter addiction-related behaviors including reward, dependence, and relapse. To uncover these drug-related molecular changes, we utilize mouse models of nicotine exposure to recapitulate aspects of addiction. This study aims to validate the repeated injection model of chronic nicotine exposure for future molecular studies. Specifically, we propose that chronic nicotine exposure would alter locomotor behavior that occurs immediately following drug exposure. For chronic nicotine exposure, mice (n=8-10 per group) were acclimated in locomotor activity chambers for 4-8 sessions before receiving one of five different doses of nicotine (vehicle, 0.05, 0.2, 0.4, 1.0 mg/kg; s.c.) for 5 sessions. Behavioral measures of activity (locomotor distance, immobility time, and immobility episodes) were quantified using AnyMaze video tracking software. The following results will quantify changes in these behavioral measures within session (pre-injection versus post-injection) and between sessions (Nicotine Session 1 vs Session 5). Validation of the repeated nicotine injection model will facilitate future studies identifying molecular changes that facilitate behavioral dysfunctions.

Mentor(s): Dr. Matthew Buczynski (Virginia Tech; Neuroscience), Ann Gregus (Virginia Tech, Department of Biochemistry)

ELAINE METZ HOLLINS UNIVERSITY / BIOLOGY

Testing Naturally Occurring Verticillium Fungi for use as a Biological Control of the Invasive Tree-of-Heaven (Ailanthus altissima).

Ailanthus altissima, or the Tree-of-Heaven, is an invasive Chinese tree species that outcompetes native vegetation and is difficult to eradicate throughout North America. Two naturally occurring fungi species in the Verticillium genus have caused wilt symptoms and mortality in Ailanthus trees in Virginia. This study tests the efficacy of Verticillium fungi as a biological control with the hope that it may replace pesticides currently used on Ailanthus trees. Ailanthus saplings were inoculated with conidia of Verticillium dahliae and nonalfalfae in a greenhouse experiment to test the effect of both fungi on the tree. The height and health of each tree was measured weekly. Preliminary results of this ongoing experiment will be presented and analyzed using the area under the disease progress curve (AUDPC). This greenhouse experiment is part of a larger project inoculating natural Ailanthus stands across Virginia to test the potential use for Verticillium as a biological control.

Mentor(s): Dr. Scott Salom (Virginia Tech, Entomology)

COLE REEVES VIRGINIA TECH / FISH CONSERVATION

Big Stony Creek Brown Trout Diet Pilot Study

Brown trout are a species that have become prevalent in North America, adapting to rivers and streams throughout most of the U.S. and Canada since their introduction from northern Europe in the late 1800s. To understand the role of brown trout in the broad diversity of rivers and streams they inhabit, a more granular approach is necessary. To that end, this pilot study takes a close look at one particular system, Big Stony Creek, to determine what information is needed to characterize the diet of the brown trout in that system. A standard way to see what fish are eating is to analyze their gut contents. This study aims to determine how many gut samples are necessary to characterize brown trout diet in this particular river system using species accumulation curves for species identified in gut samples. To obtain gut samples, we captured fish with the use of a backpack electroshocker and dip nets. We then sedated them and performed gastric lavage to obtain their gut contents which were placed in alcohol for subsequent identification. In order to obtain data on prey availability, I placed drift nets in areas where we had performed backpack electroshocking to cross-reference with the diet samples. During the course of this pilot study 45 trout were lavaged and their gut contents analyzed. This poster presentation discusses the results of the species accumulation curve analysis, comparisons of the drift net data and the gut sample data, and the efficacy of the lavage techniques employed.

Mentor(s): Dr. Kathryn McBaine (Virginia Tech; Fish & Wildlife, Zachary Martin (Virginia Tech; Fish & Wildlife)

LAURA STANGE VIRGINIA TECH / ENVIRONMENTAL HORTICULTURE

Wildflower Establishment and Pollinator Populations in Virginia

As the population of pollinators decline, we must support the important ecosystem service they provide. Wildflower plots on the edge of agricultural farms create habitats that provide a source of food and shelter for pollinators. With correct establishment practices, creating a functioning ecosystem to support pollinators can become a hands-off reality for farmers who have a few plots of unusable or inferior farmland. This project studies the effect of different wildflower plot establishment techniques on the population of visiting pollinators. The treatments consisted of till or roundup, and 5 different seed mixes. Observations of the number and type of pollinators as well as floral preference patterns were recorded. The data shows that pollinators exhibit strong floral fidelity which differs among species, and that plots treated with round-up had higher bloom and pollinator counts. The data also suggests that wild bees are mostly attracted to flower species, such as Black-Eyed Susan, that are not favored by either honey or bumble bees. Concluding, this experiment illustrates the importance of native bees in addition to their more well-known counterparts.

Mentor(s): Dr. Megan O'Rourke (Horticulture)

ALEXANDRA TOLOCZKO VIRGINIA TECH / CHEMICAL ENGINEERING & NEUROSCIENCE

The Prevention of Non-Resolving Inflammation and Restoration of Monocyte Homeostasis

Low-grade non-resolving inflammation is evident in ongoing clinical cases such as atherosclerosis, cardiovascular disease, and diabetes. This consistent low-grade inflammation causes the hostÃ¢â‚¬â„¢s immune system to shift to a non-resolving pro-inflammatory state, leading to progression of disease and degradation of health. Therefore, by treating monocytes, critical cells involved in inflammation, with 4-phenylbutyrate, we aim to prevent non-resolving inflammation and restore monocyte homeostasis. For this project, wild type murine monocytes were treated with PBS or LPS in vitro for nine-hours and then harvested. Monocytes express an inflammatory marker for chemokine receptor 5 when activated, therefore by using real-time PCR, levels of inflammation were examined by comparing varying levels of CCR5 expression. Additionally, Nucleoporin 62 is produced when there is autophagy failure in the cell, resulting from a disrupted sub-cellular network due to inflammation. Therefore, by using western blots, P62 concentrations were able to be determined. Upon determining the expression levels of CCR5 and P62 by LPS stimulation, the cells grown in either PBS or LPS were successfully treated with the autophagy restoration agent 4-PBA.

Mentor(s): Dr. Liwu Li (Virginia Tech; Immunology)

SEDONA WHITMORE VIRGINIA TECH / PSYCHOLOGY

Parent-Child Conversations and Children's Healthy Snack Choices

Pediatric obesity has become an epidemic. Parents and caregivers play important roles in their children's weight management, including healthy eating and physical activity. Entity and incremental implicit theories are underlying beliefs concerning whether characteristics are fixed, stable aspects of the person that cannot be changed, or malleable, able to be improved upon through effort and strategy. The present study evaluates parents' use of entity and incremental themes about healthy habits by recording conversations between parents and children during three tasks: discussing their favorite meals, healthy and unhealthy decisions, and what snack to choose. Both a community sample of 40 parent-child dyads (24 girls, 16 boys; mean age = 10.3 years) and an intervention sample of 24 parent-child dyads (11 girls, 13 boys; mean age = 10.5 years) participated. Transcripts of conversations were coded for incremental and entity themes. Interrater reliability was good (Ks > 0.79). Because incremental theories emphasize changeability, it was hypothesized that when parents use more incremental themes, their children will make healthier snack choices, especially when the family is seeking pediatric obesity intervention. This was not supported. However, parents' use of entity statements, which suggest that healthy habits are not changeable, was correlated with children's less healthy snack choices. This is consistent with theory and previous research. Future research might examine peer communication regarding healthy habits as well as parent-child communication. Cultural context is also important to explore. Findings are applicable to pediatric obesity intervention and prevention programs.

Mentor(s): Dr. Julie Dunsmore (Virginia Tech; Psychology)

Global Forum Undergraduate Summer Research Lab

PROGRAM DESCRIPTION

The Global Forum on Urban and Regional Resilience (GFURR) at Virginia Tech, Hollins University, and Roanoke College has initiated a collaboration to lead an undergraduate research lab in Roanoke for the summer of 2017. Four faculty members from Virginia Tech and Hollins University guided and supported 17 students from the three institutions who were accepted to participate in the program.

The Summer Undergraduate Research Lab is a paid 10-week program designed to give students the opportunity to engage in research that explores pertinent issues in the city of Roanoke. The program used Roanoke as a living laboratory to expose students to the collection, analysis, and synthesis of primary data.

RESEARCH LEADER:

Dr. Jim Bohland,

PROJECT COORDINATOR:

Dr. Jim Bohland,

INSTRUCTORS:

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Jon Bohland, International Studies (Hollins University)
Tom Skuzinski, Urban Affairs and Planning (Virginia Tech)
Cermetrius Bohannon, Landscape Architecture (Virginia Tech)

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Global Forum Undergraduate Summer Research Lab

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SASHA SHARMA VIRGINIA TECH / PSYCHOLOGY
ABBY WILSON VIRGINIA TECH / SOCIOLOGY

Refugee Summer Lab

This group seeks to understand how and in what ways refugees are civically engaged in the Roanoke Valley. In order to address this, we explore the role of civic engagement from the perspectives of the community organizations and refugees' communities. In addition to ethnographic literature, we use other ethnographic methods over the course of ten weeks as we interview organizations, civic leaders, and individual refugees. The results compare services that support civic engagement in Roanoke to other cities in Virginia. This project culminates in a presentation to a community-based audience for the purpose of initiating dialogue about civic engagement of refugees in the Roanoke Valley.

Mentor(s): Dr. Rebecca Hester (Virginia Tech, Global Forum / Science & Technology in Society), Dr. Jon Bohland (Hollins University, International Studies)

MAJA GABRIELSON

VIRGINIA TECH / PUBLIC & URBAN AFFAIRS, URBAN PLANNING & POLICY

Perceptions of Low-Income Residents about Multi-Modal Transportation Accessibility in Roanoke, Virginia

Many small sized cities around the nation are undergoing large planning and policy changes as they realize the need to create multi-modal transportation options for all residents. For instance, Asheville is trying to create a low energy public transportation system to cut down on emissions while Chattanooga is gearing up to launch an app for their public transit system. Roanoke, Virginia is another small city that is undergoing new city developments that call for a greater focus on improving public transit. Although many of these cities are investing in new developments, they are unfortunately leaving out the portion of the city that matter the most: the residents. A large gap in small cities is the lack of community engagement especially in topics such as multi-modal transportation.

This study helps to fill this gap by investigating the community perceptions of transportation and accessibility specifically in low-income neighborhoods within Roanoke. The purpose of this study is to give public officials and other policymakers in Roanoke an idea of what the public wants and needs, which will hopefully influence future transportation plans within the city. I used an online survey (n í¢äóÁ Ê 30) administered via five neighborhood association intermediaries. Preliminary findings from the study suggest that the transportation system should incorporate adequate lighting and sidewalks, as a majority of users expressed concerns about safety especially at night. Respondents also wanted to improve the system for transferring between routes as the current bus system proves difficulty surrounding transfers specifically.

Mentor(s): Dr. Thomas Skuzinski (Virginia Tech, Urban Planning and Policy), Dr. C.L. Bohannon (Virginia Tech, Landscape Architecture)

REBECCA GOOD
VIRGINIA TECH / LANDSCAPE ARCHITECTURE

The Impact of Demographic Differences on the Use of Roanoke City Public Parks

Despite research on how demographic differences affect the use of public space, little time has been taken in looking at these differences at the scale of smaller, neighborhood parks in small American cities like Roanoke. In Roanoke, a small city whose demographic differences align with geographic differences due to continuing economic and racial segregation, this research gap is especially important to fill in order to better design and modify public parks to maximize use by and safety of local populations. This research focuses on park use habits in four areas of the city: the Southeast, Southwest, Northeast, and Northwest quadrants. .This study uses a two phased mixed-methods design. The first phase utilized an online survey focused on resident's perception on neighborhood park safety and frequency of use at different times of the day, concerns, and desired program elements when picturing their "ideal park". The second phase of the study included on-site observations of how residents used the parks, identification of physical characteristics, and possible impacts of physical space on perceptions of safety. Preliminary results suggest there are differences in the use of parks among different areas of the city, and these differences may be attributed in part to demographic differences, but also to physical characteristics of the park, including those that affect the park's feeling of safety or danger, as well as the different relationships or parks with adjacent land uses on streets fronting the parks. This study of public life in the city of Roanoke is part of the body of research on impacts of perception of a space on its use, social cohesion and social capital, and environmental justice, and how these fields overlap in centering on the public.

Mentor(s): Dr. Cermetrius Bohannon (Virginia Tech, Landscape Architecture), Dr. Thomas Skuzinski (Virginia Tech, Urban Affairs & Planning)

LAURA HOGAN
HOLLINS UNIVERSITY / INTERDISCIPLINARY IN SOCIAL SCIENCES
WITH AN EMPHASIS IN ELEMENTARY EDUCATION

Roanoke City Community Engagement

The goal of this research project is to answer the questions: 'What community engagement processes are being involved with the planning and development of the Innovation Corridor?' and 'What is the community's perception of the engagement?' Despite the many studies on community engagement and the vast methods of community engagement, there have not been enough studies on community engagement specifically in mid-sized cities developing Innovation Corridors and what engagement methods work best in these cities. Using Roanoke City as a case study, this research evaluates the community engagement used in the Innovation Corridor and the perception of the community on said engagement. The methods used to research these questions are literature analysis and surveying residents of Roanoke City, specifically in the Southeast neighborhood because of its close proximity to the Innovation Corridor. After the data has been collected from surveying the residents, it will be analyzed to illuminate the findings on community engagement that could be useful for Roanoke City and stakeholders of the Innovation Corridor. My goal is to ultimately produce findings that could better equip the planning and development stakeholders with ways to engage the community.

Mentor(s): Dr. C.L. Bohannon (Virginia Tech, Landscape Architecture), Dr. Tom Skuzinski (Virginia Tech, Urban Affaris & Planning)

IRA LONG III
VIRGINIA TECH / POLITICAL SCIENCE

The State of Workforce Development in Roanoke City

The subject of this paper is the future of workforce development in the city of Roanoke with emphasis on the Innovation Corridor. We observe the state of workforce development in Roanoke to reveal possible improvements that may be made through cooperation between local schools, businesses and government. This paper examines the feasibility of developing an accessible skills training program through area schools for local residents. We anticipate that developing such a program could be possible with the participation and sponsorship of local businesses and additional funding assistance by local, state or federal government. Interviews were conducted with potential stake holders from the public and private sector. Primary data collected from interviews conducted in-person made it possible to understand the perspectives of potential stakeholders and what would be required of all parties involved in the development of skills training program. We expect that representatives of potential stakeholders will express interest in such a program with the expectation that there may be cooperation between the public and private sector. Information gathered from this paper may be referenced for future research about sector-based strategies of development in practice.

Mentor(s): Dr. Thomas Skuzinski (Virginia Tech, Urban Affairs & Planning)

MADISON MCELHINNEY
HOLLINS UNIVERSITY / INTERNATIONAL STUDIES

Innovation Roanoke: Public and Private Sector Relationships

This study is to begin to understand what the relationship has been like between the public and private sectors within the Roanoke Innovation corridor. By looking at the relationship between the public and private sectors we can begin to build a greater understanding of how these private-public Partnerships begin to work and for the interest of the city we can begin to determine the various avenues that can be taken to protect the public's interest. The anticipated findings for the study is that the public and private sectors have been equally working together to not only allow the innovation corridor to be beneficial for the private sector but also safeguarding the public's interest. The methods for analyzing my data has consisted of qualitative analysis. I have collected my data primarily through interviews. These interviews have allowed for an in-person response to the question they were asked and allowed for direct answers. This allowed me to analyze the responses I have gathered and compared them other responses. This analysis was to gain a greater understanding of what the private and public partnership consisted of throughout the development of the corridor.

Mentor(s): Dr. Thomas Skuzinski (Virginia Tech, Public & International Affairs), Dr. C.L. Bohannon (Virginia Tech, Landscape Architecture)

SAM RAUF
ROANOKE COLLEGE / ECONOMICS

Public vs. Private Perceptions about Economic and Community Development in Roanoke, VA

This research focuses on differing perceptions among private stakeholders, public officials, and neighboring communities on needed improvements in the innovation corridor near downtown Roanoke, Virginia. The goal is to make development recommendations for the corridor based on how different members of the community feel. This qualitative study utilized an online survey to collect data from neighborhood organizations, private stakeholders of the innovation corridor, and public officials in Roanoke.

Preliminary results indicate a difference in perceptions among private stakeholders and the neighboring communities. Private stakeholders want to see an increase in business development, apartments, and the expansion of healthcare services such as Virginia Tech Carilion and Jefferson College. The public living around the innovation corridor wants to have community gardens, and preserve the historic district that neighbors the innovation corridor. All three groups of the community that were surveyed put emphasis on walking and public transportation as their preferred method of getting around the city and the innovation corridor.

Mentor(s): Dr. C.L. Bohannon (Virginia Tech, Landscape Architecture), Dr. Tom Skuzinski, (Virginia Tech, Urban Affairs & Planning)

NATALIE TOBIAS
VIRGINIA TECH / INDUSTRIAL DESIGN

Study of accessibility barriers to mobility-impaired persons in Roanoke, VA

This research focuses on the experiences, opinions, and backgrounds of mobility-impaired persons and/or caretakers of mobility impaired persons concerning accessibility in Roanoke, VA. The purpose of this study is to understand the daily impediments mobility-impaired persons face including road infrastructure and public building accessibility. This mixed methods study utilized an online survey as well as observations of accessibility in user-specific areas to collect data. The questions in the study are all related to the participants' perceptions of accessibility in public spaces. Results from the study thus far indicate that curbs, sidewalks in poor repair, and lack of connectivity are among the most impeding to mobility-impaired persons' accessibility. Study findings will be used in publications and presentations targeted to policy makers, designers, and academics, with the goal in mind that general policy recommendations concerning universal design and the removal of infrastructure barriers will be implemented in Roanoke, VA.

Mentor(s): Dr. C.L. Bohannon (Virginia Tech, Landscape Architecture), Dr. Thomas Skuzinski (Virginia Tech, Urban Affairs & Planning)

LESLIE UPTEGRAFF

VIRGINIA TECH / ENVIRONMENTAL POLICY & PLANNING

Travel Behavior and Preferences Among Healthcare Workers in Roanoke's Innovation Corridor

The purpose of this project is to identify the transportation habits, preferences, and perceptions of the healthcare workers in Roanoke's Innovation Corridor. The study is intended to provide insight on the connection between the transportation resources available to the workers and whether or not their choices can be correlated with the distance, duration, and type of commute. The significance of this study is to offer an explanation of the transportation demands in Innovation Corridors and the implications that they might have on development patterns and policies. The population that is used in the study includes workers of Carilion Clinic and Virginia Tech Carilion Research Institute (VTCRI). This reflects the largest workforce population and largest spatial composition in the Innovation Corridor. A questionnaire was distributed to the workers email addresses to survey their current transportation methods, perceptions, and demographics to gather qualitative and quantitative data. Preliminary findings from the survey of VTCRI workers suggest that there may be a correlation between the distance of the workers homes and their place of employment reflected in their mode utilized and duration of their commute. However, the data also suggests that the workers have a strong preference for unimodal transportation and chose automobile over other methods, regardless of the distance traveled to work. Across all methods of transportation, the workers report a 75% level of satisfaction with their commute. Those who bike or would like to bike to work reference safety, weather, and time as a barrier to usage.

Mentor(s): Dr. Thomas Skuzinski (Virginia Tech, Urban Affairs & Planning), Dr. C.L. Bohannon (Virginia Tech, Landscape Architecture)

HOLLY WATERMAN
VIRGINIA TECH / LANDSCAPE ARCHITECTURE

Improving Connectivity and Engaging the Public in the Roanoke Innovation Corridor

The Roanoke Innovation Corridor is a medical and research district developing through a partnership with Carilion, Virginia Tech, and the City of Roanoke. Located near downtown, the corridor is an effort to boost economic growth and bring the city to the forefront of medical research. This research focuses on methods of improving connectivity and public engagement within the Roanoke Innovation Corridor, and between the corridor and the surrounding city. Currently, there is a lack of connection between the different buildings associated with the corridor, as well as between the corridor and its surroundings. To approach this issue, this research investigates how this problem has been addressed in finished projects of a similar type.

This study examines university, research, and medical campuses throughout Europe: to understand different ways other cities have addressed connectivity and public engagement issues. Data was gathered in the form of photos, written observation, and sketches, and analyzed to determine patterns. Anticipated results of this data indicate several methods of using these patterns within the Innovation Corridor in Roanoke to help create improved connections and increase public engagement. Implications of this information include furthering the City's mission to boost economic growth, improve environmental quality of the area, and establish the district as a social as well as intellectual center.

Mentor(s): Dr. C.L. Bohannon (Virginia Tech, Landscape Architecture), Dr. Tom Skuzinski (Virginia Tech, Urban Affairs & Planning)

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DAVID BARTO
VIRGINIA TECH / BIOCHEMISTRY

Molecular Modeling of Amyloid Aggregation

Alzheimer's disease (AD) is a neurodegenerative disease that results in irreversible memory loss and dementia. AD is a significant public health concern, affecting one of every ten people over the age of 65 in the U.S. AD pathology is generally characterized by neuronal cell death and loss of long-term potentiation in the hippocampus and prefrontal cortex. The specific mechanism of AD is mostly unknown, but soluble oligomers of amyloid beta (Aβ) are thought be one of the principal toxic species. Due to the transient nature of Aβ oligomers, elucidating the specific oligomer species involved in Alzheimer's and their mechanism of action has been difficult. Here, we hope to show the solvated quaternary structures of the most biologically relevant Aβ oligomers (dimer through dodecamer) through molecular dynamics simulations utilizing the GROMOS 53A6 force field. For each oligomer complex, we will characterize the compactness by calculating the radius of gyration, flexibility by calculating the root mean squared fluctuation, secondary structures via the algorithm DSSP, and the hydrophobicity of the oligomers using the solvent-accessible surface area. Through this, we hope to demonstrate common conformational domains in most or all of the lower-order Aβ oligomers that contribute to a shared mechanism of neurotoxicity, which may then be targeted for treatment of AD. Finally, the structures determined by this study may be used as a starting point to conduct future in silico experiments involving Aβ.

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

REBECCA BUTTON
COMMONWEALTH GOVERNOR'S SCHOOL / CURRENTLY IN HIGH SCHOOL

3D Engineering of Synthetic Tumors

Conflicting data from in vitro, in vivo, and clinical studies exist regarding the magnitude of the contribution of therapeutic agents in disease treatment, particularly in the treatment of most forms of cancer for which the long-term risk of disease relapse is ~30%. Although much of our understanding on how cells divide, migrate, and die have been generated by studying cells on two-dimensional (2D) surfaces; processes such as morphogenesis, tissue remodeling, and metastasis alter the 3D organization of the microenvironment itself making it difficult, if not impossible, to recapitulate these processes in 2D culture systems. To more closely capture the conditions that cells experience in vivo, we have developed a 3D sacrificial printing system to generate biodegradable scaffolds of filament networks to grow spheroid-printed cells in a defined architectural matrix and keep them viable for long periods while allowing real-time bioluminescence recording. We aim to use this technology to provide a more realistic assessment of the impact of the cellular microenvironment and systemic factors in tumor development when adhesive, mechanical, and chemical components are taken into consideration.

Mentor(s): Dr. Carla Finkielstein (Virginia Tech, Biological Sciences)

CHELSEA CEREGHINO
VIRGINIA TECH / MICROBIOLOGY

Diverse and dynamic bacterial communities inhabit root nodules of soybean

A widely-used food and abundant protein source for livestock, soybean is a world-wide crop that is highly dependent on nitrogen fixation by root nodule-inhabiting bacteria for growth. The diversity of bacteria that live in these nodules, how they differ between cultivars, and how they change seasonally have not been described. Nine diverse soybean cultivars were grown at Kentland Farm (Virginia Tech). Nodules were harvested in 2014 and 2016 in either late July or early August. DNA was extracted, amplified (16S rRNA gene), and submitted for sequencing (Illumina MiSeq). In 2014, a diverse community of both Bradyrhizobium (5 taxa, >1%) and non-Bradyrhizobium taxa (e.g. Pseudomonas) were observed. Significant differences in the nodule community composition between cultivars were observed, but the communities were dominated by bacteria most closely related to Bradyrhizobium japonicum USDA 6 (c. 15% to 55% abundance) and Bradyrhizobium elkanii WSM2783 (c. 38% to 75% abundance). Other bacteria (non-Bradyrhizobium) such as Pseudomonas account for up to 10% of nodule bacteria. In contrast, significant differences in community composition were not observed between cultivars in 2016 but were, nevertheless, still dominated by B. elkanii WSM2783 and B. japonicum USDA 6. Results indicate that co-dominance of soybean nodules by these and a diverse set of other bacteria is common and changes with season. The variation in nodule taxa between cultivars and seasons are expected to have an influence on soybean acquisition of bacterial fixed nitrogen and yield. These changes need further investigation to understand the drivers and consequence of soybean nodule community change.

Mentor(s): Dr. Mark Williams (Virginia Tech, Horticulture)

LEECILING CHEA
VIRGINIA TECH / COMPUTER SCIENCE

Revitalizing the LEWAS Interactive Display for Education

The LEWAS Interactive Display is outdated and disorganized in the information provided and the web development design. The goals of this project are to have a responsive display fit to any screen resolution, to clean up the code for readability, to update the information, and possibly revamp the display and design. Technology has integrated students' learning with virtual labs, research, and online modules. With right design and technology, a display or kiosk can inform and teach students about multiple educational disciplines allowing for better learning and encouraging educational pursuits. These types of virtual learning help students who don't have proper access to traditional learning. To achieve a responsive display, we implemented the use of Flexbox, a layout mode for Cascading Style Sheets (CSS) and responsive design techniques. With standard styling and name scheme, it improved the readability of the code. We conducted a survey with high school teachers on the effectiveness of the display for a student's learning. The survey was based on a Usefulness, Satisfaction, and Ease of Use (USE) Questionnaire and then customized for our LEWAS Display. In the month period, our display could fit on any screen resolution, and our code improved in precision and readability. The survey showed positive aspects for the likelihood of improving a student's education. Teachers wanted the display more geared to high school students, so there is a need to revamp the display and design. We will improve our display and design to increase the ability for students to learn and grasp educational studies.

Mentor(s): Dr. Debarati Basu (Virginia Tech, Engineering Education)

DALLECE CURLEY
VIRGINIA TECH / CLINICAL NEUROSCIENCE

Predictive Validity Across Measures of Anxiety-Like Behavior in Animal Models

In the United States, a traumatic brain injury (TBI) occurs every 5 seconds, with 75% of these injuries being mild or concussive. Mild TBI/Concussion can cause patients to suffer long-term memory loss, concentration difficulty, and general cognitive deficits. In the absence of primary brain damage the underlying cellular mechanisms have remained a mystery. Astrocytes, star shaped glial cells in the brain, respond to brain injury with astrogliosis. This process aids in sealing off damaged from uninjured brain areas, but can come at the cost of housekeeping properties of astrocytes that ensure proper neuronal function. Yet, most research thus far has centered around types of TBI with a clear site of injury, the experimental equivalent of gunshot wounds. Little is known about the astrocyte response to mild TBI/Concussion. Here, we used a mouse model of repeated mild TBI/Concussion to assess key features of astrogliosis, which includes astrocyte proliferation. Aldh1l1-eGFP mice, which label astrocytes with green fluorescent protein, were injured using the standard mild TBI paradigm, then immunohistochemistry was performed using antibodies against GFP, Ki67, and BrdU. Quantification of astrocyte densities showed no change in densities in areas with GFAP+ astrocytes, and so far no indication that these astrocytes proliferate. We did however find uncharacteristic reduction of GFP-reporter and proteins crucial for astrocyte's supportive proteins in astrocytes in other areas. This indicates that astrocytes respond very differently to mild TBI/Concussion than has previously been observed in other types of TBI, and that astrocyte dysfunction might contribute to the pathobiology in this context.

Mentor(s): Dr. Stefanie Robel (Virginia Tech, Neuroscience)

TAYLOR FLYNN
VIRGINIA TECH / CLINICAL NEUROSCIENCE

Predictive Validity Across Measures of Anxiety-Like Behavior in Animal Models

DNA methylation is an epigenetic control process that affects gene expression, and which is catalyzed by DNA methyltransferases (DNMTs). Changes in DNMT3a expression have been implicated in anxiety (Elliot, et al., 2016). In order to investigate the role of DNMT expression in the developing brain, our lab injected DMNT3a and DNMT3b siRNA into the amygdala of neonatal Sprague-Dawley rats. Anxiety- and depression-like behavior was measured using a battery of behavioral tests including the open field test, elevated plus maze, social interaction test, forced swim test, and sucrose preference test. Behavioral tests used to measure anxiety-like behavior in rodents generally target specific behavioral domains, and the results are used to more generally discuss changes in anxiety-like behavior. Predictive validity is the degree to which the outcome of one test accurately predicts the outcome of related test. Because it is impossible to truly quantify "anxiety" in an animal model, and we are instead limited to measures of isolated anxiety-like behavioral phenotypes, it is important to compare predictive validity of behavioral tests used in a study of anxiety-like behavior. The present study investigates the correlations and predictive validity of the measures used to quantify anxiety-like behavior in the DNMT knockdown rats. Better understanding the genetic correlates of anxiety could create lead the way to new and innovative therapies, interventions, and treatments to improve the quality of life for those living with anxiety.

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

TAYLOR FLYNN
VIRGINIA TECH / CLINICAL NEUROSCIENCE

Validation of Emotional Avatars

Are a set of 6 avatars, created for an intervention study to improve facial emotion recognition (FER) in individuals with autism spectrum disorder (ASD), perceived by a sample of college students as expressing their target emotion?

FER is the ability to discern the emotional state of another individual from his or her facial expressions, and is considered an aspect of social cognition (Lozier, Vanmeter, and Marsh, 2014). ASD describes a range of neurodevelopmental disorders associated with restricted interests, repetitive behaviors, and communicative and social deficits, including deficits in FER (Smith et al., 2010). As part of an intervention designed to improve FER in adults with ASD, a software system compatible with the Hololens augmented reality headset in which participants interact with a series of avatars as they are instructed to identify the emotions of the avatars was developed. The purpose of the present study was to validate the avatars used in the aforementioned study.

A survey was created and made available to Virginia Tech students through the SONA Experiment Management System. The survey required participants to view 32 videos of avatars expressing the basic six emotions, and 17 videos of avatars expressing complex emotions. Participants selected the emotion they believed the avatar was showing from six options (target emotion and five foils).

Preliminary analyses suggest support for the validation of avatars' basic emotional expressions and tenuous support for some, but not all, complex emotional expressions.

Mentor(s): Dr. Susan White (Virginia Tech, Psychology)

SARA FREIX
VIRGINIA TECH / BIOLOGICAL SYSTEMS ENGINEERING

Crayfish Responses to Water Quality Parameters: A Case Study

This study investigates observed abnormal crayfish behavior at the base of the Webb Branch watershed, on September 20th, 2016. Recordings, collected by a video camera at the Learning Enhanced Water Quality Assessment System (LEWAS) Lab site, located at the outlet of Webb Branch on the Virginia Tech campus, indicates that some of the crayfishes move faster than normal, upstream and/or onto the shore. To establish visual evidence of the abnormal behavior of the crayfish, video tracking analysis has been applied by breaking down the video footage into frames (2883 frames per hour of real-time data) and recording pixel locations of each crayfish in each image used as x and y coordinates. In order to explore the cause of the behavior, water quality data, including, water temperature, pH, turbidity, dissolved oxygen, specific conductivity and oxygen reduction potential, which are measured at the site and recorded in a database, have been collected and analyzed for the period of the event. During the event, there was a significant spike in specific conductivity and pH, a slight increase in temperature, and a drop in dissolved oxygen levels. This study explored the effects of various water quality parameters on a variety of crayfish species and hypothesized the existence of the relationship between specific conductivity, caused by unknown pollutants, and unorthodox crayfish behavior.

Mentor(s): Dr.Vinod Lohani (Virginia Tech, Engineering Education), Yousef Jalali (Virginia Tech, Engineering Education), and Daniel Brogan (Virginia Tech, Post-Doctoral Scholar in ICTAS)

MONICA HACKETT
SPELMAN COLLEGE / HEALTH SCIENCE

Science communications: Using a Web-based Newsletter to Inform Scholars and Stakeholders About Science Education Programs at Virginia Tech

The purpose of this study is to determine whether the use of a web-based newsletter is an effective and efficient method of dispersing science-related information. To conduct this study, we mainly used the online tool, Mailchimp: Marketing Automation Platform, to disperse information regarding the Virginia Tech IMSD, PREP, and Carver programs. Mailchimp is a creative and relatively easy way to send out organized information to a large or small group of people. The effectiveness of the newsletter can be measured by a combination of factors included in the mailchimp "campaign report", such as number of recipients, delivery success, open rate, click rate, and international reach. However, feedback from recipients, both positive and negative, will be the main determining factor. The effectiveness of the letter has many variables to be considered as well, including but not limited to day and time of day the letter was sent, recipient email correctness, and recipient email influx. The anticipated outcome is to limit the possible variables, expand our reach, and create a newsletter that inspires networking and information/ data sharing among scholars.

Mentor(s): Dr. Ed Smith (Virginia Tech, Animal and Poultry Science)

LOGAN HEALY
VIRGINIA TECH / ARCHITECTURE

Analysis of the Sustainability and Infrastructural Restructuring of Former Open Pit Mines

The creative challenge of this study is to analyze the sustainability of the former Lavender Open Pit Mines, with regards to innovative community structure and affordable housing.

Purposes of this study is to examine, document and analyze the Lavender Open Pit Mine as an architectural site. The site would be used to provide an interesting location for restructuring a suburban/rural community as well a sustainable energy generator from the former mine's waste products and body of water. This study will also offer research for modular housing units based off research from metabolic architecture.

The methods used in this study would involve extensive research into the Lavender Open Pit Mine: what was mined, structural diagrams of pit, remnants of waste and recovery, infrastructure of circulation networks, and other aspects of design. Research will also include categorizing and visiting actual sites; documenting, measuring, and analyzing the mine and its remaining site. The scholarship funding would go towards means of travel to the mine in Bisbee, Arizona, lodging in the nearby town, and provide for any possible admitting fees to said site, including any additional safety equipment needed to enter sites.

The expected outcomes of this research project is to create a site analysis document that will include the research conducted before, during and after site visitation. This document will include: aerial photographs and context/history, on-site photographs, sketches and scaled drawings (site plans and contour mapping, sections), models and model photographs. This document may be used for an exploration of sustainable architecture and urban planning and a potential site for thesis work.

Mentor(s): William Galloway (Virginia Tech, Architecture)

JONATHAN HUAMAN
VIRGINIA TECH / CLINICAL NEUROSCIENCE

Altered metabolic function in limbic brain of rodent model bred to display vulnerability to anxiety- and depression-like phenotype.

The molecular underpinnings of many affective disorders have yet to be identified. While neurotransmission dysfunction has been associated with the pathophysiology of affective disorders, other theories posit that disturbances of metabolic activity within certain limbic brain regions also plays a role. The present study uses a rodent model of a depression/anxiety-like phenotype to examine how metabolic differences in the limbic brain may relate to high levels of anxiety and depression-like behavior. Specifically, we use rats bred for low vs. high behavioral response to novelty; low novelty responding (LR) rats exhibit high levels of anxiety- and depression-like behavior compared to high novelty responding (HR) rats. Our previous transcriptome profiling revealed metabolism-related gene differences in the amygdala and hippocampus of LR vs. HR rats. We also found evidence of metabolic differences in the developing HR/LR brain by examining activity of Cytochrome C Oxidase (COX), an electron transport chain complex. The current study aims to find if these differences persist in adulthood. We found reduced COX activity in the amygdala and increased in hippocampus of LR versus HR rats. We next analyzed basal oxygen consumption with a Seahorse Biosciences XF24 Flux analyzer. In these ongoing experiments, we expect oxygen consumption rate (OCR) levels to correlate with COX activity in both the amygdala and hippocampus. Overall, our results add to a growing literature suggesting that perturbations of metabolic and mitochondrial activity in the limbic brain may lead to disparate emotional behavioral phenotypes and affect vulnerability to emotional disorders.

KELLY HURLEY
VIRGINIA TECH / BIOCHEMISTRY

Fighting Bacteria with Bacteria: Determining Effects of Biocontrol against Fire Blights on Apple Trees

Fire blight disease found on apple trees is caused by the pathogen Erwinia Amylovora. Agricultural companies have suffered severe loss due to the presence of fire blights and they're high resistance to some antibiotics such as Streptomycin. The purpose of this experiment is to test the bacterial species our lab has collected from rain (Pantoea, Bacillus, and Pseudomonas) and against the effect of the tree pathogen. The three different objectives of this experiment are to A) determine which strains have the best antagonistic activity against the pathogen, B) discover if the selected biocontrol strains have the same antagonistic effects in field conditions, and C) determine if the biocontrol strains have an effect against the symptoms seen in apple tree blossoms.

Mentor(s): Dr. Boris Vinatzer (Virginia Tech, Department of Plant Pathology and Weed Science)

MATTHEW HYLAND
VIRGINIA TECH / NEUROSCIENCE

The Effects of SSRI Exposure on the Domains of Depression-Like Behavior in Rats

In the United States, approximately 15 million adults are affected by major depressive disorder every year. Selective serotonin reuptake inhibitors (SSRIs) have been the mainstay treatment for the past 25 years. Unfortunately, neither the etiology of depression, nor the full effects of SSRIs, are completely understood. To better understand the effects of SSRIs in the clinical setting, it is imperative to further elucidate the effects of SSRIs in this multifaceted disorder. To do so, a well validated model organism should be used to demonstrate the different domains of depression, including anhedonia, self-neglect, and social withdrawal. The purpose of this experiment is to assess new tests which may better measure depression-like behavior in rodents. For this experiment, male Sprague-Dawley rats were treated with the SSRI citalopram or normal water (control). On postnatal day (P)75, they underwent four behavioral tests to evaluate the effects of SSRI treatment on these behavioral domains. The elevated plus maze (EPM) is a measure of anxiety, the splash test is measure self-care behavior, and the female urine sniffing and sucrose preference tests are measures of hedonic and reward-seeking behavior. We hypothesize that SSRI treatment will not affect anxiety-like measures in the EPM, but that rats treated with citalopram will show greater self-care and reward-seeking behavior. Further tests will attempt to confirm the well-established effects of SSRI treatment on behavioral despair (Forced Swim Test). The results of this study will help determine whether these tests, in their current form, are suitable measures of these behavioral domains.

Mentor(s): Dr. Sarah Clinton (Neuroscience)

SARAH KIM

VIRGINIA TECH / CLINICAL NEUROSCIENCE

The metabolic activity of cytochrome c oxidase in the limbic system of adult rat models of depression

Depression and anxiety are the most common types of mental disorders. Human neuroimaging studies have shown abnormal metabolism within limbic brain regions of individuals suffering from major depression. Oxidative phosphorylation (electron transport chain) is the main energy producing pathway in neurons, and cytochrome C oxidase (COX) is the terminal rate-limiting enzyme of this process. COXÃ¢â‚¬â„¢s activity in the brain is correlated to ATP production and thereby, energy production. The goal of this project is to measure the metabolic activity within the hippocampus and raphe, key regions associated with depression-like behavior in rodents. Our lab utilizes selectively bred rats that show distinct differences in novelty reactivity. The Low Responders (LRs) exhibit high levels of anxiety- and depression-like behavior and the High Responders (HRs) exhibit increased exploratory behavior and low levels of behavioral inhibition. COX activity was measured utilizing histochemistry techniques in several brain regions of HR/LR rats to determine if the proposed metabolic differences are present in this model organism of depression, and to determine in which limbic brain regions the differences may exist. Our results show that the average COX activity was reduced in the raphe nucleus of those with depression-like behavior in the Cornu Ammonis and dentate gyrus subregions of the hippocampus. These findings, along with future studies, may further support that mental illnesses involve abnormal brain metabolism, as well as lead to new therapeutic treatments that can prevent or treat such disorders.

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

SOPHIA LEE
VIRGINIA TECH / ENVIRONMENTAL SCIENCE: WATER SCIENCE AND QUALITY

Friend or Foe? Pseudomonas and its Colonization of Soybean Root Nodules Decreases Plant Growth

Depression and anxiety are the most common types of mental disorders. Human neuroimaging studies have shown abnormal metabolism within limbic brain regions of individuals suffering from major depression. Oxidative phosphorylation (electron transport chain) is the main energy producing pathway in neurons, and cytochrome C oxidase (COX) is the terminal rate-limiting enzyme of this process. COX's activity in the brain is correlated to ATP production and thereby, energy production. The goal of this project is to measure the metabolic activity within the hippocampus and raphe, key regions associated with depression-like behavior in rodents. Our lab utilizes selectively bred rats that show distinct differences in novelty reactivity. The Low Responders (LRs) exhibit high levels of anxiety- and depression-like behavior and the High Responders (HRs) exhibit increased exploratory behavior and low levels of behavioral inhibition. COX activity was measured utilizing histochemistry techniques in several brain regions of HR/LR rats to determine if the proposed metabolic differences are present in this model organism of depression, and to determine in which limbic brain regions the differences may exist. Our results show that the average COX activity was reduced in the raphe nucleus of those with depression-like behavior in the Cornu Ammonis and dentate gyrus subregions of the hippocampus. These findings, along with future studies, may further support that mental illnesses involve abnormal brain metabolism, as well as lead to new therapeutic treatments that can prevent or treat such disorders.

Mentor(s): Dr. Mark Williams (Virginia Tech, Horticulture)

HUNTER MOORE
VIRGINIA TECH / CLINICAL NEUROSCIENCE

Evaluating the microbiota's role in emotional behavior: antibiotic treatment exacerbates anxiety in high anxiety-prone rats

Recent studies indicate that the microbiota influences brain function and emotional behavior, effects that may be mediated via changes in integrity of the blood-brain barrier. To investigate the role of the microbiota in regulating emotional behavior, we utilize a model of individual differences in temperament where rats were selectively bred for high versus low novelty seeking behavior. Low Novelty Responder (LR) rats exhibit high levels of anxiety- and depression-like behaviors compared to High Novelty Responders (HR). We hypothesized that HR/LR rats may exhibit microbiome differences that could contribute to their distinct neurobehavioral phenotypes. To test this, we treated adult HR/LR males with a regimen of antibiotics in their drinking water for two weeks prior to and throughout behavioral testing. 16s RNA was extracted from fecal samples to determine possible baseline HR/LR microbiome differences, as well as the impact of antibiotics on the microbiome. Microbiome sequencing analysis did not reveal any major differences in the composition of the baseline LR versus HR microbiome. Antibiotic treatment predictably reduced the number species present in the microbiota and it had a similar effect in HR and LR animals. However, antibiotic treatment exacerbated HR/LR behavioral differences such that antibiotic-treated LRs showed significantly higher levels of behavioral inhibition and anxiety-like behavior compared to LR controls. Antibiotic-treated HRs showed higher levels of exploration and less anxiety-like behavior compared to HR controls. Ongoing experiments are interrogating potential mechanisms whereby antibiotic treatment exaggerated HR/LR behavioral phenotypes, including examining possible effects on the blood-brain barrier.

Mentor(s): Dr. Matthew Glover (Virginia Tech, School of Neuroscience)

HISYAM MOHSIN
VIRGINIA TECH / CIVIL & ENVIRONMENTAL ENGINEERING

Effect of Road Salt on the Lead Level in Plumbing System

Lead is harmful to human body and can cause serious health problems including: high blood pressure, miscarriage, and damage to children's brain development. With efforts to minimize lead in water exposure starting in 1986, most newly installed household plumbing components are "lead free". However, homes constructed before this date may be at risk, as plumbing networks may contain leaded solder. In addition, homes with "lead free" brass faucets and fittings are still concern, as brasses could contain up to 8% lead until 2014. The use of road salt has increased from 1 million tons in 1955 to 27 million tons in 2014. For this reason, chloride in drinking water sources (streams, lakes, rivers) across northern U.S., Canada, and Europe have increased. This may be problematic for home plumbing systems, as increased of chloride levels can potentially corrode lead solder and leaded brass at a faster rate. Therefore, this study examines the influence of increased road salt concentrations on lead leaching from lead solder and brass. When exposing lead solder coupons and brass wires to four levels of chloride (<10-1,000 mg/L), lead in water level ranged from 15.4-26,000 µg/L for lead solder and 11.8-251 µg/L for brass which is 0.8-1,700 times higher than the EPA action level of 15 µg/L. The lead in water level for lead solder increases by 10-1,200 times and the weight loss of leaded brass wires increased by 3 times, as the chloride level increased from 10 to 1000 mg/L. This experiment illustrates that: (1) lead level increase as the chloride levels increases for lead solder but not brass and (2) higher chloride levels, increase corrosion rates of lead solder and brass.

Mentor(s): Dr. Marc Edwards, Dr. Kelsey, Dr. Jeff Parks, Dr. Min Tang, (Virginia Tech, Civil & Environmental Engineering)

WENTING SHI
VIRGINIA TECH / CHEMICAL ENGINEERING
DANIEL ESSANDOH
VIRGINIA TECH / CHEMICAL ENGINEERING

Controlled Drug Delivery System

The general goal of this project is to develop a controlled drug delivery system for cancer nanomedicine, and evaluate its feasibility. Controlled drug delivery focuses on the method of giving drugs continuously for prolonged time periods in a controlled fashion [1]. It has the advantages of improved efficiency, reduced toxicity, maintenance of drug levels within desired range, and fewer administrations [2]. The core of the delivery system is the optical fiber, which is coated by PLA, PLGA, and rhodamine B (a tracer dye used in place of the medicine). After releasing rhodamine B in PBS, the data is obtained by HPLC to analyze the relationship between the releasing time and the percent of release. As the result, the dye is released fast at first, slowly down over time, and it can be kept until 48 hours. Therefore, its continuous and long-range release achieves the idea of controlled drug delivery. For the next step, the fibers with real medicines will be applied on the tumor inside mice. The efficiency of this drug delivery system will be kept studying by the vivo experiments.

Mentor(s): Dr. Rong Tong (Virginia Tech, Department of Chemical Engineering)

Graduate student mentors: Ai Lin Chin and Yongliang Zhong, (Virginia Tech, Department of Chemical Engineering)

TRISTAN STOYANOF
VIRGINIA TECH / BIOLOGICAL SCIENCES

Chemoreceptor McpS and its Affinity for Specific Ligands

Methyl-accepting chemortaxis proteins (McpÃ¢â‚¬â„¢s) assist in the chemotaxis of bacteria. These chemoreceptors bind to ligands found in their immediate vicinity and cause the activation of motor proteins, allowing the bacteria to move either towards or away from a chemical gradient. Sinorhizobium meliloti is a root-nodulating organism for alfalfa and has nine distinct chemoreceptors. The ligands its chemoreceptors bind to are primarily exuded by the roots into the rhizosphere of the soil. In this project, McpS was purified and studied using differential scanning fluorimetry (DSF) to determine which ligands the protein binds to. The significance of the specific chemoreceptor is tested by inoculating two sets of host plants, one with a wild-type of S. meliloti and the other with a strain lacking McpS. To evaluate, the number of nodules and the dry weights of the plants are recorded. These root nodules help the plant fix nitrogen into a usable form, thus benefitting the plant while also giving a safe and nutrient-rich shelter for the bacteria. Agricultural implications could include higher crop yields and alleviating the use of environmentally hazardous fertilizers. Future projects will include studying the other eight chemoreceptors and their impacts on root nodulation.

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

Multicultural Academic Opportunities Program

PROGRAM DESCRIPTION

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 DIRECTOR:

Dr. Jody Thompson Marshall

PROGRAM PARTICIPANTS

Aaron Brock

VIRGINIA TECH*, Microbiology*
Faculty Mentor: Dr. Birgit Scharf

Nicole Eng

LAFAYETTE COLLEGE, *Biology*
Faculty Mentors: Dr. Birgit Scharf

Cristina Nardini

THE COLLEGE OF NEW JERSEY, *Psychology*
Faculty Mentor: Dr. Kendra Sewall

AARON BROCK
VIRGINIA TECH / MICROBIOLOGY

Ascertaining the role of the che2 operon in Sinorhizobium meliloti using bacterial two-hybrid screening

Sinorhizobium meliloti is a nitrogen-fixing, soil bacterium that engages in a symbiotic relationship with leguminous plants. It locates to the roots of plants via chemotaxis, a way motile cells move in the environment responding to chemical substances. By studying how S. meliloti chemotactically interacts with the environment, we will help improve crop health, crop returns, and the general knowledge of chemotaxis physiology. This research is investigating a set of genetically linked chemotaxis genes, named the che2 operon. While a great deal of information is known about S. meliloti's che1 operon, the che2 operon is expressed during the motile phase and there are indications that it is expressed during plant interaction.

The che2 operon has five genes: cheR, cheB, cheW, mcpS, and cheAY. CheW is an adaptor protein that relays information between the methyl accepting chemotaxis proteins (MCP) and a histidine kinase, McpS is an MCP used as a sensor for chemoeffectors, and CheAY is a fusion protein of CheA, a cytoplasmic histidine kinase, and CheY, a response regulator. FlcA is located upstream of this operon and is a putative response regulator that transcriptionally regulates genes. We hypothesize that the che2 operon is regulating FlcA activity.

Using a bacterial two-hybrid screening in Escherichia coli, the genes encoding adenylyl cyclase (AC) subunits from Bordetella pertussis, T18 and T25, can be fused with genes coding for proteins from the che2 operon. Protein interaction can then be observed through the restoration of AC activity on MacConkey medium, which are types of indicator plates that are used for screening lactose fermentation. Through understanding the interactions of these proteins and their role in host-plant interaction we can further grasp and eventually improve upon S. meliloti's contribution to agriculture.

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

NICOLE ENG
LAFAYETTE COLLEGE / BIOLOGY

Investigating the role of an uncharacterized bacterial protein during infection of Agrobacterium sp. H13-3 by phage 7-7-1.

Bacteriophage 7-7-1 infects Agrobacterium sp. H13-3, a gram-negative soil bacterium, via the flagellar filament. This rotating, thread-like appendage helps the bacterium move through viscous environments and serves as the initial receptor for phage 7-7-1. The current hypothesis is that the phage uses the rotation of the filament to propel itself down to the bacterial cell surface where it then interacts with other receptors. However, the mechanism by which phage 7-7-1 injects its viral DNA is unknown. Previous work in the lab indicates that disruption of a gene that encodes for a hypothetical inner membrane protein of unknown function results in resistance to phage 7-7-1 infection. Based on an analysis from PredictProtein webware, three putative DNA binding sites were identified within the protein. The aim of this study was to determine the role of this protein in viral DNA transport by substituting the amino acids in positions 48, 55, and 103 to alanine. Mutant Agrobacterium sp. H13-3 cells were created via allelic exchange. The mutants were confirmed by Sanger sequencing and evaluated for sensitivity to phage 7-7-1 infection via plaque assay. The results of this study will provide insight into the mechanism by which phage 7-7-1 infects Agrobacterium sp. H13-3 and a better understanding of the role this protein plays during infection.

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

CRISTINA NARDINI
THE COLLEGE OF NEW JERSEY / PSYCHOLOGY

The effect of lead exposure during the critical postnatal period on learning ability

The developing brain is extremely vulnerable to environmental conditions, and some conditions can impair brain function and learning ability. The environmental contaminant, lead, can compromise neurobehavioral development early in life, posing a major health concern for children. Though the cellular and molecular effects of lead exposure have been studied, little is known about the long-term cognitive consequences of lead exposure during development. In the current study, songbirds were used to test the effects of lead on cognition because their song learning is analogous to human speech development, they have defined neural circuitry for vocal learning that is similar to humans, and spatial learning is important to their ecology and can be quantified in the lab. To assess the impacts of lead on vocal learning and spatial memory, zebra finches were treated with control water or water contaminated with lead levels equivalent to those ingested by children in Flint, Michigan (1000 ppb and 100 ppb), from hatch until sexual maturity. Songs from male birds were recorded and metrics representative of the first words spoken by a human child were extracted, including vocabulary, motor coordination, and word accuracy. All birds were then tested on a spatial task. The results mirror findings in children and show that lead exposure during the critical postnatal period compromises learning ability into adulthood. Future work on the effect of lead exposure on specific neural circuits underlying vocal and spatial learning will resolve how lead impacts the brain to compromise learning and may help produce effective interventions.

Mentor(s): Dr. Kendra Sewall (Biological Sciences)

NSF/RET Site: WaterECubeG (Engineering, Ecology, Environment, + Geosciences)

PROGRAM DESCRIPTION

This NSF-RET site on WaterECubeG is a collaborative effort among faculty members in the Colleges of Engineering, Science, and Agriculture and Life Sciences. The Institute for Critical Technology and Applied Science (ICTAS) hosts this site. First cohort of 10 teachers (RET scholars), 8 from High Schools and 2 from Community Colleges in SW Virginia, were recruited in summer 2017 for a 6-week program to work on various interdisciplinary water research projects. They also participated in a professional development program including field trips and learning module development activities.

These RET scholars will infuse their research experiences into their courses during academic year 2017-18. 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. The site will continue in the summers of 2018 and 2019. The site activities are coordinated by the faculty and students in the Learning Enhanced Watershed Assessment System (LEWAS) lab.

PROGRAM DIRECTORS:

Dr. Vinod K Lohani, Engineering Education & ICTAS
Dr. Randy Dymond, Civil & Environmental Engineering

PROGRAM PARTICIPANTS

Jodie Caldwell

LORD BOTETOURT HIGH SCHOOL,
Teaches: Ecology, Human Anatomy & Physiology, Biology
Faculty Mentor: Dr. Bryan Brown

Carla Corvin

CHRISTIANSBURG HIGH SCHOOL,
Teaches: Biology & Ecology
Faculty Mentor:Dr. Zhen (Jason) He

Katharine Davenport Davis

BLACKSBURG HIGH SCHOOL,
Teaches: Chemistry, Independent Student Research
Faculty Mentor: Dr. Marc Edwards

Anna Delgado

WILLIAM FLEMING HIGH SCHOOL,
Teaches: Biology
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Karen Hicks

GLENVAR HIGH SCHOOL,
Teaches: Chemistry
Faculty Mentor: Dr. Kang Xia

Yangsoo Kim

VIRGINIA WESTERN COMMUNITY COLLEGE,
Teaches: Physics
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NSF/RET Site: WaterECubeG (Engineering, Ecology, Environment, + Geosciences)

PROGRAM PARTICIPANTS *continued*

Alicia Lowe

FRANKLIN COUNTY HIGH SCHOOL,
Teaches: Biology, Ecology, AP Environmental Science
Faculty Mentor: Dr. Kang Xia

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Teaches: AP/DE Biology
Faculty Mentor: Dr. Amy Pruden

Rachelle Rasco

CARROLL COUNTY HIGH SCHOOL,
Teaches: STEM Lab Manager
Faculty Mentor: Dr. Vinod Lohani

Jason Worley

PATRICK HENRY COMMUNITY COLLEGE,
Teaches: Biology
Faculty Mentor: Dr. Madeline Schreiber

JODIE CALDWELL
LORD BOTETOURT HIGH SCHOOL / TEACHES: ECOLOGY, HUMAN ANATOMY & PHYSIOLOGY, BIOLOGY

Community Composition of Benthic Macroinvertebrates and Water Quality Along a Sediment Gradient

Sedimentation, although a natural process along rivers and stream, is exacerbated through anthropogenic land-use activities such as agriculture, timber harvesting, mining, and residential and commercial development. Previous studies have indicated the deleterious effects sedimentation has on aquatic communities and organisms, such as benthic macroinvertebrates, as the sediment blankets the organisms, or displaces their homes, food sources, and hiding places. Benthic macroinvertebrates are common bioindicators of aquatic habitats as they are relatively sedentary and unable to escape deteriorating water conditions, have long life cycles, and several species demonstrate sensitivity to pollutants/contaminants. The purpose of this research project is to demonstrate the direct relationship of increased sedimentation and decreased diversity in community composition of benthic macroinvertebrates. Sites were selected based on their proximity to the VT StREAM Lab stations and their placement along a visible sediment gradient in Stroubles Creek on the Virginia Tech Campus in Blacksburg, Virginia. At each site, samples of benthic macroinvertebrates were collected, water chemistry data was collected, and embeddedness was assessed. Preliminary results suggest an increase in embeddedness results a decrease in water quality and lower diversity of community composition of benthic macroinvertebrates.

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

CARLA CORVIN
CHRISTIANSBURG HIGH SCHOOL / TEACHES: BIOLOGY, ECOLOGY

Enhancing Wastewater Reuse by Using Osmotic Membrane Photobioreactor (OMPBR)

With the ever-growing population of humans and limited fresh water resource, water crisis is becoming a global challenge that needs to be carefully addressed. The mounting water shortage urges process transformation to avoid direct water withdraw. Over the past decades, extensive research has focused on developing reliable approach to recover high-quality water from wastewater. Among which, innovative membrane separation technology is deemed as a promising solution to harvest reusable water. For example, the pressure-driven reverse osmosis (RO) is a widely applied membrane separation technology at the expense of energy investment. Alternatively, forward osmosis (FO) process utilizing natural osmotic pressure, instead of external hydraulic pressure, has drawn increasing attention due to its unique advantages over RO, such as low/no hydraulic pressure, reduced energy consumption, and mitigated fouling intensity. In this project, FO process is integrated with algae, forming an osmotic membrane photobioreactor (OMPBR), to potentially achieve simultaneous solar-driven wastewater treatment and energy-efficient water recovery. Algae can then be harvested as a value-added biofuel. A series of process optimization are successively performed to render maximized water recovery under an acceptable cost. Challenges, such as salinity buildup, membrane fouling control, system stability, are thoroughly investigated. The synergistic effect between algae and FO process is evaluated, and energy consumption on the system level is quantified. The preliminary results confirm that OMPBR can reclaim high-quality fresh water for direct irrigation, warranting further long-term study treating actual wastewater.

Mentor(s): Dr. Zhen (Jason) He (Virginia Tech, Civil & Environmental Engineering), Dr. Shiqiang Zou (Virginia Tech, Civil & Environmental Engineering)

KATHARINE DAVENPORT DAVIS

BLACKSBURG HIGH SCHOOL / TEACHES: CHEMISTRY, INDEPENDENT STUDENT RESEARCH

Translating Applied Aquatic Chemistry Research to Introductory High School Chemistry Coursework: Developing Methodology to Determine Copper Speciation

Harnessing the disinfectant properties of an existing installed resource, such as copper (Cu) pipe, is an attractive practical engineering solution for "passive" control of opportunistic pathogens (OPs), such as Legionella, because Cu often acts as a natural biocide. However, Cu is not consistently effective in practice, as it reportedly sometimes inhibits and other times stimulates Legionella growth. Background water chemistry likely directly and indirectly influences Cu toxicity towards Legionella due to the different species (i.e., Cu(I) vs Cu(II)) and complexes that form. However, methods to determine and quantify copper speciation in drinking water have not been developed. The specific objective of this study was to adapt existing chelating and spectrophotometric methods to determine Cu speciation in drinking water. Chelex-100 sodium form resin was used to complex Cu(II) and removed via filtration. Differences in total Cu and Chelex reacted samples quantified Cu(II) at Cu concentrations from 1.6-3.5 mg/L and pH 5.31-6.07. Cu(I) was determined complexing it with bathocuproine (BCP) and reading absorbance at 484 nm. BCP doses were optimized for total Cu range of 0-3.5 mg/L. Developing these methods will facilitate studying the effects of Cu speciation on the growth of Legionella in future studies.

Mentor(s): Dr. Marc Edwards (Virginia Tech, Civil & Environmental Engineering), Dr. Amy Pruden, (Virginia Tech, Civil & Environmental Engineering), Dr. William Rhoads (Virginia Tech, Civil & Environmental Engineering)

ANNA DELGADO
WILLIAM FLEMING HIGH SCHOOL / TEACHES: BIOLOGY

How will benthic macroinvertebrate communities differ between specific areas of Stroubles Creek that have riparian coverage and those that lack coverage?

Using benthic macroinvertebrates are an accepted standard for judging water quality. Further, it allows for a deeper study and understanding of the complex nature of freshwater streams and their critical importance in ecology. Riparian zones are significant because of their diverse roles within an aquatic community: trap sediment by slowing down the flow of water, act as a final "buffer" zone between terrestrial and water habitats as they filter water coming in, prevent against plant and soil erosion and can be a very diverse community for vegetation. The goal of this research was to determine how riparian coverage, or lack of coverage, affects water quality. Another goal was to determine the actual number of individuals from each family (e.g., chironomidae, hydropsychidae) as well as nu¬mbers of families, in general. We sampled six sites in total along Stroubles Creek on the campus of VT, collected six benthic macroinvertebrate samples from each site, measured the amount of riparian coverage from three of the six sites. The prediction is that "shredder" invertebrates, like caddisflies, will be more abundant because they break down a lot of the riparian leaf litter that accumulates in more shaded areas. This littler then becomes a food source for other invertebrates in other areas of the stream; areas that are not as shaded. "Scraper" invertebrates, like mayflies, are predicted to be more abundant in areas of less shade, as they tend to feed on algae and bacteria that have begun to grow more. Preliminary results suggest that Coleoptera and Dipterans will be the most common types of invertebrates found in covered riparian zones, while Trychopterans will be the most common type found in uncovered zones.

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

KAREN HICKS
GLENVAR HIGH SCHOOL / TEACHES: CHEMISTRY

The Search for Microplastics in an Urban Stream

Plastics are a part of our daily lives. They are components of the clothes we wear, the cars we drive and the packaging for our food. As the plastics break down, either as a part of normal wear and tear, or as part of the decomposition process, particles and fibers are released into the environment. This project was designed to determine the occurrence of microplastics in an urban stream using simple techniques and equipment applicable to a high school setting. Sediment samples were collected at several sites along Stroubles Creek on the Virginia Tech campus. The sediment samples were sieved, and the fine sediment was run through an elutriation tube to separate the plastics from the soil. The material collected was further treated with a 3.3M sodium iodide solution and centrifuged to separate the lighter plastic material from heavier sediment materials. Examination of the lighter materials under a 2X and a 10X power microscope identified suspected microplastic particles. Further examination of sediment samples needs to be conducted using a 40X or higher power microscope. Digestion of biological matter using peroxide oxidation could assist in verifying the material isolated is plastic. Sampling for microplastics in the water column needs to be conducted to determine the plastic abundance.

Mentor(s): Dr. Kang Xia (Virginia Tech, Crop & Soil Environmental Sciences), Dr. William Vesely (Virginia Tech, Crop & Soil Environmental Sciences)

YANGSOO KIM
VIRGINIA WESTERN COMMUNITY COLLEGE / TEACHES: PHYSICS

Designing an Auto Water Sampling Apparatus at LEWAS Lab

The LEWAS (Leaning Enhanced Watershed Assessment System) and OWLS (Online Watershed Learning System) provide a great learning tool. Anyone all over the world can monitor continuous real-time data and/or download data files of water quantity and quality. Although various sensors can measure many parameters (e.g., stage, flow rate, turbidity, dissolved oxygen, specific conductivity, etc.), there is still a limitation in identifying sediments or pollutants in the water. Thus, collecting water samples during a special event is crucial in investigating the sediments or pollutants. Sampling by human is not convenient because events are not always predicted. Sometimes inclement weather makes it impossible or dangerous to collect water samples in person. For this reason, auto sampling is highly desirable. Even though commercial auto samplers are available, the options for the trigger conditions are limited and their price is generally high. An affordable auto sampling apparatus was designed and built during National Science Foundation (NSF) Research Experience for Teachers (RET) program. By providing the design and schematic of our prototype, we hope students in the world can build their own apparatus at their future LEWAS-like labs. This prototype will also be used in developing a future LEWAS-like system at the new STEM building in Virginia Western Community College. The overall research project and experiences will greatly enhance collaboration between engineering and science faculty to promote interdisciplinary education at Virginia Western Community College.

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

ALICIA LOWE
FRANKLIN COUNTY HIGH SCHOOL / TEACHES: BIOLOGY, ECOLOGY, AP ENVIRONMENTAL SCIENCE

Analysis of Nitrogen and Phosphorous in Soil and Water Influenced by Agricultural Practices

Soil and water can be polluted and overused in agricultural practices. An area of concern is excess nutrients, such as nitrogen and phosphorous, being applied to soil via animal manure or synthetic fertilizer. These nutrients are absorbed by the soil, but much of it washed away by precipitation or irrigation runoff. When nitrogen and phosphorous find their fate in surface waters, they can cause eutrophication within the ecosystem leading to algal blooms, hypoxic conditions, and die-offs of aquatic organisms. Additionally, as nutrients build up in soil, groundwater that becomes drinking water can be polluted and harmful to human health.

The goal of this study is to determine the levels of bioavailable nitrogen and phosphorous in soil and water samples from an area affected by long-term animal manure application. Soil and water samples collected from cropland and adjacent creek were analyzed with Vacu-vials® kits, employing UV-Vis spectroscopy to determine nitrate and orthophosphate content. Preliminary results suggest that topography impacts accumulation and that difference in accumulation between the surface and subsurface is negligible for nitrates. Orthophosphate has been found in low quantities but it remains to be determined if this is due to orthophosphate being hard to detect by our methods.

Additionally, the research in this study will be used by high school students to form hypotheses for future related research opportunities. Students will have the opportunity to create their own related experiments for an authentic, inquiry-based learning experience.

Mentor(s): Dr. Kang Xia (Virginia Tech, Department of Crop and Soil Sciences)

MARK MADDEN

CAVE SPRING HIGH SCHOOL / TEACHES: AP/DE BIOLOGY

Interplay Between Disinfectants and Microbial Population in Two Simulated Reclaimed Water Distribution Systems

With higher potable water demands, freshwater is becoming more and more scarce. The need for water sustainability is becoming critical across the world and reclaimed water has gained importance in serving as an alternative water supply. The opportunities are evident with the use of reclaimed water, but there is also reasonable concern with respect to unquantified risks, particularly with respect to the distinct microbiological characteristics of reclaimed water. Factors such as temperature, flow patterns, stagnation, and the and levels of disinfectant residuals have the possibility to shape the biochemical conditions in the system, especially oxidation-reduction profiles, which will in turn shape the microbial profile within distribution systems. Three defining features have the largest influence on the biochemical reactions, which are surface area to volume, flow velocity, and water age. This research seeks to determine the relationship between disinfectant use (chloramine and chlorine) and microbial population in a large and small reclaimed water distribution system (RWDS). It is hypothesized that the amount of disinfectant available is directly correlated with the amount of regrowth of bacteria; where more decay means less disinfectants available to prevent bacterial growth and hence more regrowth. Data will be collected on chlorine residual levels as the reclaimed water travels through the DS and compared with total cell count to determine if similar water zones of chemistry and biological activity, which is observed in the large scale RWDS, can be achieved.

Mentor(s): Dr. Amy Pruden (Virginia Tech, Civil & Environmental Engineering), Dr. Marc Edwards (Virginia Tech, Civil & Environmental Engineering)

RACHELLE RASCO
CARROLL COUNTY HIGH SCHOOL / TEACHES: STEM LAB MANAGER

Using Tracer Studies to Calculate the Dispersion Coefficient for Webb Branch

In order to comply with the Municipal Separate Storm Sewer System (MS4) permitting, one Minimum Control Measure (MCM) implemented is to create an Illicit Discharge Detection and Elimination (IDDE) plan. Illicit discharges such as sewage, detergents, and other pollutants can be detected using water quality indicators such as conductivity, temperature, and pH. To be able to eliminate the discharge, location of the pollutant's source is important. Tracer studies have been conducted to determine dispersion coefficients of pollutants in waterways. This can be used to determine the location of where that pollutant entered the waterway. The goal of this project is to calculate the dispersion coefficient of Webb Branch using salt tracer studies. A salt tracer was injected into the headwaters of the stream and then conductivity values were measured downstream by the Learning Enhanced Watershed Assessment System (LEWAS). The high-frequency continuous conductivity data were analyzed to calculate the dispersion coefficient. The initial values appear to be higher when compared with other dispersion coefficients of similar streams. Further tracer studies will be performed. The overall research project and experiences through the Research Experience for Teachers (RET) program will be used to develop STEM learning modules for Carroll County High School.

Mentor(s): Dr. Vinod Lohani (Virginia Tech, ICTAS), Dr. Randel L. Dymond (Virginia Tech, Civil & Environmental Engineering), Thomas Westfall (Virginia Tech, Civil & Environmental Engineering)

JASON WORLEY
PATRICK HENRY COMMUNITY COLLEGE / TEACHES: BIOLOGY

Iron & Manganese Oxidation Cycles in a Local Drinking Reservoir

A major issue facing the quality of drinking water is the release of iron (Fe) and manganese (Mn) into the water column from reservoir sediments due to hypolimnetic hypoxia (<2mg/L dissolved oxygen) during thermal stratification of the summer months. Fe and Mn lead to taste and odor problems, as well as corrosion and staining. Hypolimnetic oxygenation (HOx) systems have been installed in drinking water reservoirs to increase dissolved oxygen in the hypolimnion to prevent the reduction and release of soluble Fe and Mn to the water column.

In May 2013, a side stream supersaturation (SSS) system was introduced into a local drinking water reservoir located in southwest Virginia, to increase dissolved oxygen (DO) in the hypolimnion. From 2013 to 2015, the SSS was operational for different periods of time during the summer, while in 2016 and 2017, the SSS was operational through the summer months. Results suggest that during increased oxygenation, Fe oxidized much faster; however, had a lesser impact on Mn oxidation.

In this study, we are evaluating the effect the SSS has on metal concentrations in the water column since installation and to compare metal concentrations in the oxygenated reservoir to those of an unoxygenated, reference reservoir, which has no oxygenation system installed. Water samples were collected at various depths weekly from both reservoirs. Results since the installation of the SSS show lower concentrations of Fe and Mn in the oxygenated reservoir in comparison to the reference reservoir, which as elevated levels of Fe and Mn near the sediments.

Mentor(s): Dr. Madeline Schreiber (Virginia Tech, Geosciences), Dr. Cayelan Carey (Virginia Tech, Biological Sciences)

NSF/REU Site: Interdisciplinary Water Science + Engineering

PROGRAM DESCRIPTION

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. 85 excellent undergraduate researchers (55 women + 30 men) representing 55+ different institutions in the United States have graduated thus far. The fourth cycle of the site, hosted by the Institute for Critical Technology & Applied Science (ICTAS), began in summer 2017 and will continue until the summer of 2019. 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 Crop & Soil 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 and with faculty/ graduate students.
The site activities are coordinated by the faculty and students in the Learning Enhanced Watershed Assessment System (LEWAS) lab.

SITE DIRECTOR:

Dr. Vinod Lohani, Engineering Education and ICTAS

PROGRAM PARTICIPANTS

Eileen Cahill

GEORGETOWN UNIVERSITY, *Biology*
Faculty Mentor: Dr. Kang Xia

Alexandria Cook

MILWAUKEE SCHOOL OF ENGINEERING, *Biomolecular Engineering*
Faculty Mentors: Dr. Amy Pruden & Dr. Peter Vikesland

Amanda Donaldson

HUMBOLDT STATE UNIVERSITY, *Forestry*
Faculty Mentor: Dr. Erich Hester

Leah Finegold

OBERLIN COLLEGE, *Environmental Studies*
Faculty Mentors: Dr. Cayelan Carey & Dr. Madeline Schreiber

Myiah Freeman

UNC - CHARLOTTE, Civil Engineering
Faculty Mentor: Dr. Marc Edwards

Kathryn Lopez

FLORIDA STATE UNIVERSITY, *Chemical Engineering*
Faculty Mentor: Dr. Andrea Dietrich

NSF/REU Site: Interdisciplinary Water Science + Engineering

PROGRAM PARTICIPANTS *continued*

Kristine Mapili
VIRGINIA TECH*, Civil & Environmental Engineering*
Faculty Mentors: Dr. Amy Pruden & Dr. Peter Vikesland

Viktor Wahlquist
BINGHAMTON UNIVERSITY*, Electrical Engineering*
Faculty Mentor: Dr. Vinod Lohani

Zachary Perkins
UNIVERSITY OF VIRGINIA*, Environmental Sciences*
Faculty Mentor: Dr. Daniel McLaughlin

Christian White
YALE UNIVERSITY, *Mechanical Engineering*
Faculty Mentor: Dr. Zhen He

EILEEN CAHILL
GEORGETOWN UNIVERSITY / BIOLOGY

Occurrence of emerging contaminants in an urban storm water network due to impacts of sewer system exfiltration

As urbanization increases globally, pharmaceutical and personal care product (PPCP) consumption increases. Pharmaceuticals and certain personal care products contain active ingredients that can alter our body processes. These compounds flow with our waste water and impact our water purity. PPCPs have been found in a variety of water sources, including drinking water. These chemicals have the potential to unintentionally enter our bodies through ingestion. The exact response our body has to these compounds is unknown. PPCPs, in their potential to adversely impact our health, are in a class of compounds called "contaminants of emerging concern". It's crucial to think about where PPCPs in urban-impacted surface waters come from to then work toward a solution. Leaky sewers can result from pipe misalignment due to underground shifting, hydrological changes, and pressure due to high flow events. As storm water pipes run near waste water pipes, sewage exfiltration provides an opportunity for waste water contaminants to enter storm water. Storm water flows directly into surface waters. Therefore, it is important to look at sewage leakage into storm waters as a source of contamination. In testing the hypothesis that PPCP presence in urban-impacted waters is due to sewage exfiltration, water samples were taken from municipal surface waters. The samples were concentrated and cleaned through solid-phase extraction in preparation for ultra-performance liquid chromatography - tandem mass spectrometry analysis. The goal of my project is to develop the knowledge of PPCPs so that future water system solutions can be implemented to preserve human and ecological health.

Mentor(s): Dr. Kang Xia (Virginia Tech, Crop & Soil Environmental Sciences)

ALEXANDRIA COOK
MILWAUKEE SCHOOL OF ENGINEERING / BIOMOLECULAR ENGINEERING
KRISTINE MAPILI
VIRGINIA TECH / CIVIL & ENVIRONMENTAL ENGINEERING

Antibiotic Resistance in Wastewater Treatment Plants in Chennai, India

Antibiotic resistant bacteria (ARB) are known to occur in wastewater treatment plants (WWTPs) across the world and to impact their effluent-receiving environments. Antibiotic resistant genes (ARGs) embedded within the genomes of these resistant microorganisms can be transferred and spread via vertical and horizontal gene transfer. Global patterns of antibiotic resistance distribution are largely unknown, and occurrence in developing countries is of particular concern due to limited access to adequate healthcare, increasing and unregulated availability of antibiotics, and improper use of antibiotics. The objective of this study was to investigate the occurrence and distribution of ARGs across two WWTPs located in a southern coastal Indian city. Influent and effluent samples corresponding to each process in the WWTPs, including primary sedimentation, activated sludge, secondary sedimentation, and final disinfection, were collected. WWTP effluent-receiving environment samples upstream and downstream to the effluent discharge location were also taken. The suspended biomass was concentrated onto a membrane filter via vacuum filtration of the liquid samples, and subsequently subjected to DNA extraction. Metagenomic analyses will be conducted to characterize the ARG distributions within each sample. Real-time quantitative polymerase chain reaction (qPCR) will also be applied to examine the relative abundance of key ARGs of environmental and public health concern. The results obtained from this effort will help identify critical points along the wastewater treatment process where antibiotic resistance dissemination may be controlled.

Mentor(s): Dr. Amy Pruden (Virginia Tech, Civil & Environmental Engineering), Dr. Peter Vikesland (Virginia Tech, Civil & Environmental Engineering)

AMANDA DONALDSON
HUMBOLDT STATE UNIVERSITY / FORESTRY

Investigation of the Dimensions, Distribution and Abundance of Macropores Throughout Virginia

Stream interactions with the groundwater occur through the bank and bed of the channel. It is hypothesized that macropores are common in streambanks but the geometry, abundance and connectivity have yet to quantified. A macropore is a passageway, cavity, crack, tubular pore or void in the soil that transports water and solutes by gravity [Aubertin, 1971]. These structures may offer enhancements for both gill and lung model exchange and are a significant component to the ecological effectiveness of the Hyporheic Zone. The Hyporheic Zone is defined as the interface in which stream corridors and their underlying groundwater catchments exchange flow, nutrients and even contaminants [Allaire-Leung et al, 1999; Boano et al, 2014; Brunke et al, 1997]

The first step in understanding the extent macropores impact hyporheic exchange is to determine quantitative macropore parameters and their abundance in a variety of stream environments. Our objective is to document the abundance, distribution and dimensions of surface-connected macropores along stream banks in four geographic provinces of the eastern United States. We hypothesize that macropores (> 1cm diameter) will be common (average spacing <1 m) throughout all stream sizes surveyed in a multitude of stream environments. These measurements will act as important preliminary data for further investigations on how macropores impact the "lung model" hyporheic exchange in streams.

Our data so far shows that macropores were present throughout all four provinces. There seems to be an observational relationship between the soil type within the stream bank and macropore abundance.

Mentor(s): Dr. Erich Hester (Virginia Tech, Civil & Environmental Engineering), Amiana McEwen (Virginia Tech, Civil & Environmental Engineering)

LEAH FINEGOLD
OBERLIN COLLEGE / ENVIRONMENTAL STUDIES

Epilimnetic mixing events exacerbate methane ebullition flux in a small eutrophic drinking water reservoir

Inland waters are substantial sources of carbon (C) to the atmosphere. Reservoirs, in particular, emit a large portion of inland water C emissions, generally in the form of methane (CH4) bubble fluxes (ebullition) from the sediments. CH4 ebullition can contribute as much as 75% of net reservoir C emissions, however little is known how CH4 ebullition responds to water management practices like epilimnetic aeration, a common technique to prevent harmful algal blooms in drinking and recreation waterbodies. In summer 2017, we measured CH4 ebullition rates in a managed eutrophic drinking water reservoir during two planned mixing events and found a relationship between mixing and increased ebullition rates.

Mentor(s): Dr. Cayelan Carey (Virginia Tech, Biology), Dr. Madeline Schreiber (Virginia Tech, Geosciences), Ryan McClure (Virginia Tech, Biology)

MYIAH FREEMAN
UNIVERSITY OF NORTH CAROLINA CHARLOTTE / CIVIL ENGINEERING

Evaluation of Disparities in North Carolina Well Programs: The Role of Income

Private drinking wells are not regulated by the Environmental Protection Agency (EPA) and are therefore left to the well owner to maintain at their discretion. To find information regarding private wells, homeowners can visit their county well page which often lack the pertinent information to maintain the well. To determine how effectively counties are communicating with their users, a website assessment was completed to look at the following five categories: landing page, testing, disinfection, interpretation and permits. For this research US Census data from 2010 was used to determine the ten counties with the highest household income and the ten counties with the lowest household income. General qualitative statistics, readability, and GIS mapping were completed from those 20 counties. The Flesch-Kincaid Readability Test was used to assess the readability of the target counties well webpages, which returns two values: the grade level and reading ease. We concluded that the readability of the target counties well webpages were above the average reading level in America (8th grade), meaning that they were too complex for customers without higher education to read. ArcMap was used to visually map the target counties and layered with grade levels and other demographics for each county. Future steps in this project involve working with North Carolina counties to reduce both their reading ease and grade level comprehension.

Mentor(s): Dr. Marc Edwards (Virginia Tech, Civil & Enviromental Engineering), Taylor Bradley (Virginia Tech, Civil & Environmental Engineering)

KATHRYN LOPEZ
FLORIDA STATE UNIVERSITY / CHEMICAL ENGINEERING

Chemical Reduction of Geosmin Concentrations in River Water Using EarthTec®

Geosmin is a microbial metabolite that causes taste-and-odor issues in potable water. Geosmin's potent earthy odor is a nuisance to humans at ≥1-10 ng/L concentrations and its control is costly for the global drinking water industry. EarthTec® is an acidified copper-based algaecide/bactericide designed to reduce geosmin concentrations by two proposed mechanisms: through eradicating microorganisms that produce geosmin and inducing acidic dehydration of geosmin to form less odorous argosmin. This study aims to determine the effectiveness of EarthTec® at initiating the acidic dehydration of geosmin in river water from a waterway that experienced taste-and-odor issues, and to elucidate the kinetics of this reaction. A known amount of geosmin was added to river water or distilled water and then mixed with 1 or 10 ppm EarthTec®. pH and geosmin concentrations were measured before and after introducing EarthTec®. Geosmin concentrations were measured by solid-phase microextraction coupled with gas chromatography-mass spectrometry and monitored via flavor profile analysis (FPA) with a trained human panel. The 10 ppm EarthTec® dose was more effective than the 1 ppm dose at geosmin reduction. For river water, 10 ppm of EarthTec® removed 29% of the geosmin in 9 hours, reduced odor by 5 FPA odor units, and reduced the pH by 0.25 pH units. In distilled water, 10 ppm EarthTec® removed 39% of the geosmin in 8 hours and reduced the pH by 0.66 pH units. Water treatment plants can use this information to determine the optimal dose and contact time for EarthTec®.

Mentor(s): Dr. Andrea Dietrich (Virginia Tech, Civil & Environmental Engineering)

ZACHARY PERKINS
UNIVERSITY OF VIRGINIA / ENVIRONMENTAL SCIENCES

Examining Spatio-Temporal Dynamics of Streams Using a High-Frequency Water Quality Sensor

Water quality varies with both space and time, driven by factors such as land use and flow. Traditional monitoring techniques involve sampling at infrequent timescales that do not detect high-resolution variability in water quality. This project uses a high-frequency sensor to evaluate spatial variability within and between streams, in addition to temporal variability within a single stream. Turbidity, nitrate-N, and dissolved organic carbon levels were measured in sections of Stroubles Creek near Blacksburg, Virginia, and in parts of the Choptank River in eastern Maryland. Regression analysis indicated a moderately-strong positive relationship between percent agricultural land use in a watershed and nitrate levels. Heat maps were created for each water quality parameter in each stream to illustrate spatial variability within streams. Temporal variation within a single stream was also demonstrated. The results of this study not only illustrate the spatio-temporal variability of water quality in streams, but also provide strong support for the expanded use of high-frequency, automatic, in-situ water quality monitoring techniques.

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

VIKTOR WAHLQUIST
BINGHAMTON UNIVERSITY / ELECTRICAL ENGINEERING

Design of an Educational Virtual Environment: Effects of a Storm Event on a Small Urban Stream

During the last two decades, virtual reality technologies have evolved, becoming more comprehensive and prevalent. These technologies show tremendous potential as educational tools to advance active learning and teaching. Therefore, they are beginning to see widespread use in academic settings. The Learning Enhanced Watershed Assessment System (LEWAS), located in Blacksburg, Virginia, is a high-frequency, environmental monitoring system which measures water quantity and quality parameters in a small urbanized stream. The goal of this project is to design and develop an educational virtual environment capable of utilizing the data gathered by the LEWAS to accurately recreate real storm events in a virtual setting. The user will experience the environment using virtual reality technologies to facilitate immersion, engagement, and active learning.

Mentor(s): Dr. Vinod Lohani (virginia tech, engineering education)

CHRISTIAN WHITE
YALE UNIVERSITY / MECHANICAL ENGINEERING

Nutrient Recovery from Wastewater Using a Bioelectrochemical System

Microbial electrolysis cells (MECs) are wastewater treatment tools that produce electricity through the consumption of organic molecules in wastewater. Ionic transport within these systems allows for the removal of pollutants and nutrients including nitrogen based molecules like ammonium. The goal of this experiment was to investigate the ammonium recovery from a partially submerged tubular MEC and analyze the distribution between liquid cathode solution and air. This was done by running an MEC on batch mode with a synthetic waste water solution and monitoring the cathode and anode solution ammonium and COD concentrations as well as the current generation. It was found that the peak current production for the MEC with aeration was approximately 9.6 mA and without aeration 13.7 mA. The ammonium removal efficiency of the system with aeration was 97.6 % and without aeration 77% and the COD removal efficiency of the system with aeration was 84.4% and without aeration 69.9%. The ammonium had an average distribution of 84.9% in the air around the reactor and 15.1% remaining in the cathode solution. Based on these results it can be concluded that a tubular MEC has adequate potential for ammonium recovery from wastewater and that ammonium is predominantly driven out of the cathode solution in the air.

Mentor(s): Dr. Zhen He (Virginia Tech, Civil & Environmental Engineering)

RET: Biomechanics from Molecular to Organismal Scales

PROGRAM DESCRIPTION

This RET program involves in-service high school STEM teachers from the Appalachian region of southwestern Virginia and southern West Virginia, with an emphasis on serving under-resourced schools and low income student populations. Each teacher is paired on a one-to-one basis with a biomechanics research laboratory, conducting research and developing new educational material over seven weeks in the summer. Teachers work alongside faculty and graduate students, developing new skills toward addressing specific biomechanics research questions using a hypothesis-driven approach.

The partnership and interaction with the laboratory will continue throughout the following school year. Room, board, and stipend will be provided, with teachers housed on-site on the campus of Virginia Tech. During the summer research experience, teachers develop a novel standards conforming educational module to bring back to their home school, enriching their curricular activities. Teachers will qualify for professional development points that can be used toward fulfilling the requirements for license renewal with the approval of their school systems.

PROGRAM DIRECTOR:

Dr. Jake Socha, BEAM

PROGRAM PARTICIPANTS

Chris Barnes

WILLIAM FLEMING HIGH SCHOOL,
Teaches: Biology, Chemistry
Faculty Mentor: Dr. Temple Douglas

Michael Collver

BLACKSBURG HIGH SCHOOL,
Teaches: Technology of Robotic Design & Manufacturing Systems
Faculty Mentor: Dr. Shane Ross

Mark England

HURLEY HIGH SCHOOL,
Teaches: Biology
Faculty Mentor: Dr. Vincent Wang

Bruce Gidley

KING'S FORK HIGH SCHOOL,
Teaches: Technology Foundations
Faculty Mentor: Dr. "Sunny" Jung

Dawn Hakkenberg

PATRICK HENRY HIGH SCHOOL,
Teaches: Algebra
Faculty Mentor: Dr. Michelle Beck

Tiffany Hunter

WOODBRIDGE HIGH SCHOOL,
Teaches: Biology
Faculty Mentor: Dr. Daniella Cimini

RET: Biomechanics from Molecular to Organismal Scales

PROGRAM PARTICIPANTS *continued*

John Jewell
PULASKI COUNTY HIGH SCHOOL,
Teaches: Math
Faculty Mentor: Dr. Pamela VendeVord

Brittney Shaw
BOWIE HIGH SCHOOL,
Teaches: Biology, Microbiology, Anatomy & Physiology
Faculty Mentor: Dr. Robin Queen

Nitika Sood
PULASKI COUNTY HIGH SCHOOL,
Teaches: Algebra 2
Faculty Mentor: Dr. Khalid Adjerid

Renee Thompson
BOWIE HIGH SCHOOL,
Teaches: Biology, Integrated Science
Faculty Mentor: Dr. Justin Barone

Schuyler van Montfrans
WILLIAM FLEMING HIGH SCHOOL,
Teaches: Ecology, Biology
Faculty Mentor: Dr. William Hopkins

Philip Hernandez
WILLIAM FLEMING HIGH SCHOOL,
Teaches: Biology, AP Biology
Faculty Mentor: Dr. Jake Socha

CHRIS BARNES

WILLIAM FLEMING HIGH / TEACHES: BIOLOGY, CHEMISTRY

Evaluating the use of chemical deposition for light-based dielectrophoresis

This research is a component in a larger project aimed at developing a more efficient, effective, and lower cost means of evaluating the aggressiveness of cancer cells in human patients. Cancerous cells are morphologically different when compared with healthy cells. Additionally, within a tumor, the cells with greater aggressiveness and metastatic potential may be structurally unique when compared to less aggressive cancer cells. The overall project looks to exploit these morphological differences to sort the cells via dielectrophoresis.

Our project aims to develop a single self-contained microfluidic device capable of receiving a biopsy or blood sample, sorting those cells based on morphological characteristics, and then testing various chemotherapy agents on the isolated cell types to determine their relative efficacy, and in turn generate an individualized treatment profile.

Pursuant to this, a microfluidic chip has been designed using polydimethylsiloxane posts in a flow chamber, which create perturbations in the electric field generated by fluidic electrodes on either side of the chamber. By forming a frequency-dependent temporary dipole in cells within the device, we hope to trap morphologically distinct cells by tuning applied voltage, frequency, and flow rate to sort them based on morphology.

This work presents a narrow focus of this overall project, in which we worked to develop an internal protocol to modify the existing cell sorting chamber, which uses physical posts to disrupt the electric field, to instead rely on a photoreactive layer added to the chip that is activated with ultraviolet lasers. This technique presents a potential greater selectivity of the chip by varying the excitation level of the trapping points by varying laser power, and could potentially be used to move targeted individual cells arbitrarily within the device to create a biomimetic tumor environment for further cell characterization and study.

Mentor(s): Dr. Temple Douglas (Virginia Tech-Wake Forest, Biomedical Engineering & Sciences)

MICHAEL COLLVER

BLACKSBURG HIGH SCHOOL / TEACHES: TECHNOLOGY OF ROBOTIC DESIGN & MANUFACTURING SYSTEMS

Using additive manufacturing and off-the-shelf electronic hardware to develop a bimodal payload dispersal platform inspired by the autorotation observed in maple seeds.

Baby birds fledge, calves are weaned, and teenagers are driven to college. Seedling plants on the other hand grow up where they are planted. To ensure better access to plentiful resources most plants have a seed dispersal mechanism which take advantage of moving water, air or animals to carry their seeds some distance from the parent. Among wind transporters, trees of the the genus Acer encapsulate their seeds in a papery fruit (achene) modified to form a single flight surface or wing. When mature, these fruit break free and glide to the ground. Because the seed is at one end of the wing autorotation begins to create lift and thereby allows for more time to drift away from the parent. Here we attempt to create a vehicle using additive manufacturing that co-opts the intrinsic autorotation observed in certain trees species to deliver a payload from a high altitude safely to the ground. Using commercial off the shelf (COTS) circuit design elements it is hoped that the descent of the vehicle can be controlled. Using a simple altimeter circuit, a flap will be help up a higher altitudes to arrest autorotation and then folded over to initiate autorotation at a desired altitude closer to the ground. It is envisioned that a large number of these could be release over a target with the goal of using the bimodal flight characteristic to attain a desired dispersal radius.

Mentor(s): Dr. Shane Ross (Virginia Tech, BEAM)

MARK ENGLAND
HURLEY HIGH SCHOOL / TEACHES: BIOLOGY

Biaxial Tensile Properties of Peyronie's Disease Tissues

Peyronie's disease is a common, disabling condition characterized by pathologic fibrosis and/or calcification of the tunica albuginea (TA) of the penis. The disease process manifests itself most prominently as penile deformity (curvature) and pain during intercourse. The change in penile shape is most likely attributable to focal changes in the mechanical properties (e.g., stiffness) of the TA, such that the underlying pathology (e.g., fibrotic plaque) induces a gradient (difference) in TA stiffness with respect to the length and/or girth of the penis. While it has been presumed that the anatomic areas where scarring is present exhibit alterations in TA elasticity, there is minimal scientific evidence to support this concept. Characterization of the biaxial tensile properties of these pathologic tissues will form an important, clinically relevant foundation for further assessment of the efficacy of therapeutic treatments in reducing tissue stiffness.

To accomplish this goal, human pericardium tissue (graft tissues) and biopsy tissues (surgically excised penile tissue from patients with Peyronie's disease) were procured by our clinical collaborators. Ex-vivo biaxial tests of the tissue samples were conducted to map and visualize the regional variation in tensile properties in response to sub-failure loading protocols. Tissue surface strains along the circumferential and longitudinal axes of the samples were measured using the digital image correlation (DIC) method during biaxial tension tests. With the stress-strain data obtained through these tension tests, the strain-dependent elastic modulus (Young's modulus) was calculated for the PD tissues.

Mentor(s): Dr. Vincent Wang (Virginia Tech, BEAM), Daniel Surinach (Virginia Tech, BEAM)

BRUCE GIDLEY
KING'S FORK HIGH SCHOOL / TEACHES: TECHNOLOGY FOUNDATIONS

Agricultural Disease Spreading by Rain Drop Impact.

This research is focused on disease spreading through rain drop splash dispersion patterns resulting in "Leaf Rust" also known as Crop Contamination.The motivation is upon completion of this experiment to hopefully better understand how wind and water separately and combined causes "crop contamination".
The research methods used to conduct this experiment include but are not limited to: a high speed camera, a syringe to reproduce the rain droplet. The analysis being conducted is on the velocity and angle of the droplet landing on a glass slide replicating the actual rain droplet landing on the surface of a Katsura Leaf. Based on the data collected by the high speed cameras the hope is to better understand how disease is spread from plant to plant, crop to crop.

Mentor(s): Dr. "Sunny" Jung (Virginia Tech, Biomedical Engineering & Mechanics), Dr. Seong Jin Kim (Virginia Tech, Biomedical Engineering & Mechanics)

DAWN HAKKENBERG

PATRICK HENRY HIGH SCHOOL / TEACHES: ALGEBRA

Does lead exposure influence male attractiveness in zebra finches?

Since the Flint water crisis, lead exposure has come to the forefront as an environmental threat to children and remains a threat to wild organisms as well. Developing effective therapies to treat lead exposure hinges on identifying both the signs and impacts of the exposure. Many songbirds possess ornaments that are influenced by condition and serve as signals of quality to conspecifics. Because these ornaments are condition-dependent, they may be affected by lead exposure and could affect mate choice. In our study, we used zebra finches, Taeniopygia guttate to assess the impact of lead treatment on male ornamentation and on female mate choice. We quantified the orange hue, a mate choice cue in this species, of male cheek patches and bills. We performed mate choice trials, allowing females to choose between lead treated males and controls. Lead treated males had significantly brighter bills, but significantly lower carotenoid chroma than control males, suggesting that lead treated males deposited fewer carotenoids into their bills than control males. This could be signal a lower quality to conspecifics. We expect that the females will spend more time with the control males rather than the lead treated males. We will have established that lead impacts ornamentations and could influence reproductive options in this species.

Mentor(s): Dr. Michelle Beck (Virginia Tech, Biology)

PHILIP HERNANDEZ
WILLIAM FLEMING HIGH SCHOOL / TEACHES: BIOLOGY, AP BIOLOGY

Tongue-stick: Novel method of tongue-flick in Chrysopelea paradisi during gap-bridging

In Scleorglossan reptiles, tongue-flicking, defined as a movement of the tongue out of and then back into the mouth, is known to serve important sensory functions. Tongue flicks collect airborne particles and transfer them to the vomeronasal organ in the mouth, where the sensory receptors are located. The tongue can also be utilized for tactile sensing; however, the extent of this is not yet known. When arboreal snakes, such as flying snakes, navigate their environment, they often cross gaps between branches, using visual and tactile cues. We have observed a different type of tongue-flick behavior that may allow snakes to gather tactile information about the snake's surroundings and possibly aid in gap crossing.

To explore the use of tongue-flicking behaviors in flying snakes, Chrysopelea paradisi , we will characterize and compare tongue-flicking behaviors during feeding and gap-bridging events using digital videography. Kinematics of the tongue and head (head velocity, tongue oscillation rate and number, duration of flick, and frequency of tongue-flick events) will then be derived in order to characterize each tongue-flick behavior.
This study describes, for the first time, a novel tongue-flicking behavior—a "tongue stick"—wherein the tongue is extended and kept static for a period of time. The high occurrence of the behavior during gap-bridging, as well as the long duration of the tongue protrusion, and lack of oscillation, suggest a novel use of the tongue, presumably to aid in gathering tactile information before gap-crossing.

Mentor(s): Dr. Jake Socha (Virginia Tech, Biomedical Engineering & Mechanics), Sharri Zamore (Virginia Tech, Biomedical Engineering & Mechanics)

TIFFANY HUNTER
WOODBRIDGE HIGH SCHOOL / TEACHES: BIOLOGY

Investigating the effect of altered centromere stiffness on spindle pole separation in mitotic cells

Proper chromosome segregation during cell division is essential for the growth and development of an organism. Incorrect chromosome segregation leads to an abnormal number of chromosomes, or aneuploidy, a condition typically incompatible with normal development and involved in tumorigenesis. Thus, understanding how mitosis is regulated is of utmost importance. Accurate chromosome segregation is regulated by attachments between kinetochores (protein structures that assemble on the centromeric regions of chromosomes) and microtubules emanating from the poles of the mitotic spindle. Whereas it has been for a long time that microtubules can produce forces to move chromosomes, we hypothesize that the chromosomes can, in turn, produce forces, via their kinetochores on the mitotic spindle. To test this hypothesis, we investigated the effect of reduced centromere stiffness on spindle pole separation. To this end, we treated PtK1 cells (Potorous tridactylus, female rat-kangaroo kidney epithelial cells) with the histone deacetylase inhibitor Trichostatin A (TSA), which was previously shown to increase centromere elasticity. The Eg5 inhibitor STLC was also added to prevent spindle pole separation as cells entered mitosis, and MG132, a proteasome inhibitor, was added to prevent premature mitotic exit. After two hours, cells were washed out of STLC, but kept in TSA+MG-132. The control samples were processed in the same manner, but without TSA. Immediately after STLC washout, the cells were imaged by time-lapse, multi-point phase contrast microscopy using either a 40x or a 60x objective for a three-hour period. The videos were subsequently analyzed for evidence of spindle pole separation or lack thereof.

Mentor(s): Dr. Daniella Cimini (Virginia Tech, Biocomplexity Institute), Alyssa Osimani (Virginia Tech, Translational Biology, Medicine, & Health), Nico Baudoin (Virginia Tech, Translational Biology, Medicine, & Health)

JOHN JEWELL
PULASKI COUNTY HIGH SCHOOL / TEACHES: MATH

Brain Buster: The Effect of TBI on Astrocyte Response

Traumatic brain injury (TBI) is defined as an impact, penetration or rapid movement of the brain within the skull that results in altered mental state. There are two types of TBI's, impact and non-impact. Impact TBIs are defined as when the head makes direct contact with another object. Non-impact TBIs are defined as when the head encounters a non-impact force such as blast waves or rapid acceleration and deceleration. TBI creates a mechanical and biochemical disruption in the brain which leads to the unbalanced distribution of ions and neurotransmitters, altered metabolism and ultimately cell death. Astrocytes represent one of the most important cell types for maintaining brain homeostasis. Astrocytes make up 30-65% of the cells in the brain. The roles of the astrocyte include maintaining osmotic balance and optimal ionic conditions for neurons, information processing via neurotransmitter recycling, and metabolite homeostasis. Due to the high percentage and many roles of the astrocyte we have decided to focus our study primarily on this type of cell. In this study, we are assessing astrocyte response to blast-type TBI. Cells are seeded in a six well dish and submerged in water in a blast chamber. On the opposite end of the chamber from the cells we will have piece of steel string pulled tightly across a metal bridge. An electrical current will be sent through through the wire causing it to explode thus creating a shockwave in the water. The impact of the waves on the cells creates a scenario of a TBI. These blast trials are paired with a control (sham) that endure the same environment but with no blast. Next, we are going to extract the protein from the cells using Trizol at time points up to 48 hours post-injury. Western blotting will be conducted using a Wes machine, from ProteinSimple, to quantify the protein levels. Our specific target protein is c-Jun. C-Jun regulates a wide range of cellular processes, including cell proliferation, death, survival and differentiation. We are focusing on c-Jun in this study because prolonged activation of c-Jun can cause changes in gene expression which may play a role in astrocyte response to injury. One study at the University of Miami (Florida) used hypothermia to treat hyperthermia caused by a TBI. The study showed that c-Jun activation levels decreased after 15 minutes of hypothermia.

Mentor(s): Dr. Pamela VendeVord (Virginia Tech, Biomedical Engineering & Mechanics), Nora Hlavac (Virginia Tech, Biomedical Engineering & Mechanics)

BRITTNEY SHAW
BOWIE HIGH SCHOOL / TEACHES: BIOLOGY, MICROBIOLOGY, ANATOMY & PHYSIOLOGY

Changes in Limb Symmetry During Two and Four Mile Runs

Past research on limb asymmetry during running has focused on asymmetry of runners tested with treadmills (Girard, et.al, 2017). A novel device, pedoped (Novel, Munich, Germany), measures the normal force between the foot and shoe, which serves as a surrogate measure for the vertical ground reaction force. The ground reaction force is the force exerted by the ground on the human body. Traditionally, ground reaction forces are measured using a tri-axial force plate so that the 3 components of the force (anterior-posterior, medial-lateral, and vertical) can be measured independently. While this method of assessing load on the lower extremity is standard, it is not possible to assess load outside of the laboratory setting. However, most athletes do not train or compete in controlled environments like a laboratory. Therefore, the purpose of this study was to test athletes running outside using the pedopeds to assess changes in loading symmetry during a 2 mile and a 4 mile run.

We hypothesized that asymmetry will exist in both a 2 mile and 4 mile run, and that the loading patterns will change as the subject fatigues. Each runner was asked to complete a 2 mile run and a 4 mile run at least one week apart. The loading data was recorded using Novel's pedoped application on an iPod Touch throughout the run. After the completion of the run, the loading data was extracted using a custom Matlab script from 20 step intervals at three time points (25%, 50%, and 75% of the total run). In order to assess changes in symmetry, the limb symmetry index (LSI) was calculated between limbs on subsequent steps at each time point. The impact peak LSI is the absolute value of the difference in impact peak between limbs divided by the mean impact peak multiplied by 100 percent. The average of the LSI for each time interval during each of the runs was calculated, and differences in side-to-side asymmetry were analyzed between genders and between runs. Thirty subjects will be recruited by the completion of the study. Currently, seven females and twelve males have been tested for the study. Preliminary analysis indicate that the LSI values for the 2 mile run had a mean of 19.8 with a standard deviation of 10.47 at 25%, 23.55 with a standard deviation of 8.51 at 50% and 21.90 with a standard deviation of 9.23 at 75% of the total run. For the 4 mile run there was a mean of 23.06 with a standard deviation of 7.91 at 25%, 21.78 with a standard deviation of 8.95 at 50% and 22.87 with a standard deviation of 8.88 at 75% of the total run.

Mentor(s): Dr. Robin Queen (Virginia Tech, Biomedical Engineering and Mechanics), Kristen Renner (Virginia Tech, Biomedical Engineering and Mechanics)

NITIKA SOOD
PULASKI COUNTY HIGH / TEACHES: ALGEBRA 2

Measuring variation in stiffness of insect tracheal tubes using atomic force microscopy.

Insects breathe using a complex network of tracheal tubes which deliver oxygen by diffusion to every cell of the body. Some tubes are reinforced with rings of hardened fibers called taenidia. In some insects, including some beetles, these tubes have been observed to collapse and re inflate rapidly, coinciding with pressure rises in the insect. These cyclic deformations produce a bulk flow of air in the tubes, augmenting diffusion. However, not all tubes collapse in the same way, with a unique folding 'pock' pattern in some tubes. Why do tracheal tubes collapse in non-uniform patterns? One hypothesis is that tracheal tubes vary in stiffness along their length, and regions of locally reduced stiffness collapse preferentially. To test this hypothesis for variation in collapse pattern, we measured Young's modulus at known increments along the length of the major tracheal trunks of the darkling beetle Zophobas morio. We used atomic force microscopy to apply a force at known increments along the length of the tubes both on and between taenidia, and recorded their displacement. This is a novel study on variation of mechanical properties of tracheal tubes in insects, which will help to understand how mechanical properties contribute to active respiration and can also serve as a platform for bio-inspired design of micro tubes.

Mentor(s): Dr. Khalid Adjerid (Virginia Tech, Biomedical Engineering and Mechanics)

RENEE THOMPSON
BOWIE HIGH SCHOOL / TEACHES: BIOLOGY, INTEGRATED SCIENCE

Protein Activated Rubber Curing

In this work, the vulcanization kinetics and mechanical properties of protein and isoprene rubber (IR) composites are characterized. Our group has previously shown that trypsin hydrolyzed gliadin (THGd) protein can function as both a cure activator and reinforcing filler in synthetic IR. Here, we compare the tensile properties of a THGd:IR composite to a traditional zinc oxide (ZnO) and stearic acid (STE) activated system with carbon black (CB) as a reinforcing filler. The cure kinetics are evaluated using differential scanning calorimetry (DSC) and an activation energy, Ea, required to reach a maximum cure rate is calculated. The crosslink density is estimated from a swelling ratio of the cured composites.

Mentor(s): Dr. Justin Barone (Virginia Tech, Biological Systems Engineering), Barbara DeButts (Virginia Tech, Macromolecular Science & Engineering)

SCHUYLER VAN MONTFRANS
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SYDNEY HOPE
VIRGINIA TECH / FISH & WILDLIFE CONSERVATION

The effects of incubation temperature on exploratory and feeding behavior in wood duck ducklings

In egg-laying species, incubation temperature has been shown to affect a variety of phenotypes in offspring. In birds, egg temperature is regulated by parental incubation behavior, which is costly to parents and can result in variation in incubation temperature among and within nests. Previous studies on wood ducks (Aix sponsa) demonstrated that subtle changes in incubation temperature (<1°C) affect growth rate, immune function, thermoregulatory ability, and locomotor ability, but it is unknown whether incubation temperature affects exploratory behavior and activity levels, which are correlated with food intake and growth in some species, and may be critical to offspring survival and reproductive success. Preliminary results suggest that individual ducklings incubated at lower temperatures are more exploratory than those incubated at higher temperatures, but whether this behavior is related to food acquisition while ducklings are foraging in groups remains unstudied. To investigate this, wood duck eggs were incubated at two different average temperatures (35°C and 36°C) and ducklings were grouped into broods of six (three from each incubation temperature). Broods were placed in a trial arena marked with a grid and containing 18 feeding stations, and were allowed to feed and explore for 1 hour. Through video analysis, foraging behavior was quantified, and the number of unique and non-unique grid squares visited by each duckling were counted to quantify exploratory behavior. This study has implications for the management of all avian species because parental nesting behavior, and thus incubation temperature, can be affected by a variety of anthropogenic factors, such as climate change-induced extreme weather events and habitat degradation.

Mentor(s): Dr. William Hopkins (Virginia Tech, Fish & Wildlife Conservation)

Space@VT

PROGRAM DESCRIPTION

The Center for Space Science and Engineering Research (Space@VT) resides in the Virginia Tech College of Engineering (CoE) with members from the Bradley Department of Electrical and Computer Engineering and the Aerospace and Ocean Engineering Department. Space@VT faculty lead research in both ground based, and satellite based measurements of the upper atmosphere and space weather phenomena, as well as theoretical and modeling research into space plasmas. The REU site exposes students to these various research programs and enables students to select a specific project for detailed focus.

We provide undergraduate students an engaging high-quality learning experience over a period of 10 weeks. The program will elevates the students' exposure to space weather and plasma research, while preparing them for positions in academia, industry and government. We recruit talented, motivated and diverse students, and provide them education and orientation with a series of readings, seminars, laboratory work, community-based outreach, and social and professional development activities.

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PROGRAM COORDINATORS:

Padma Carstens, Debbie Collins

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JOHN BOWMAN
VIRGINIA TECH / ELECTRICAL ENGINEERING

Analysis of AAL-PIP Battery Health Over Time

The Magnetosphere-Ionosphere Science Team (MIST) at Virginia Tech operates the Autonomous Adaptive Low-Power Instrument Platform (AAL-PIP) to monitor the magnetic field from ground level at high latitudes in the Southern Hemisphere. These systems, buried on the Antarctic Plateau, are difficult to access so on-site maintenance is limited. Here we seek to quantify the effect of age on battery performance as a necessary tool to plan equipment upgrades and model the expected lifespan of current, as well as future, deployments in the region. Nearly twelve years of hourly data returned from the system is plotted and analyzed using programs written in the Python Programming Language. This analysis is used to determine changes in the batteries' charge and discharge cycles as well as the duration for which the system can maintain peak operating voltage during each Austal Summer, when solar panels provide power. Analysis has determined that the system's battery pack has degraded over time, experiencing a longer charging period and a similar reduction in peak voltage period duration. These results suggest an upward limit for the lifespan of similar systems in the area and provide a solid footing for planning future deployment and refitting of equipment.

Mentor(s): Dr. Robert Clauer (Virginia Tech, Electrical & Computer Engineering)

MAN JUN KOH
VIRGINIA TECH / AEROSPACE ENGINEERING
KAUSHAL SEDHAI
VIRGINIA TECH / AEROSPACE ENGINEERING

SSA (Space Situational Awareness) Research: Creating an Autonomous Satellite Tracking Telescope

During the last century, space became the new frontier of innovation. Large amounts of satellites now occupy orbits around Earth. According to Space Launch Report, from 2004 to 2013, a total of 662 space vehicles launched worldwide and since the year 2014, 251 more have been launched. Critical but easily accessible resources today such as GPS, Wifi, and others could never be available without the existence of satellites. However, the increasing number of satellites has led to the problem of possible collision between satellites. Even a small crash in space can cause a great amount of space debris and it could be detrimental to other satellites near the orbit. Because of this, SSA (Space Situational Awareness) has become vital to catalog and requires constantly surveillance of the states of satellites in Earth Orbit. This resource intensive task has driven the development of commercial off the shelf telescopes to be repurposed to track satellites. Repurposed telescopes, such as one used by AFIT (Air Force Institute of Technology) have proven the success of such a system. Using these as examples, this research is dedicated to developing a satellite tracking telescope here at Virginia Tech, repurposing a cassegrain telescope. The main challenge is unique to others in that not only develop an extremely complicated go-to and tracking algorithm to complete the task that is needed, but also the implementation of the motor and mount assembly is required.

Mentor(s): Dr. Jonathan Black (Aerospace Engineering)

MICHAEL SHERBURNE
VIRGINIA TECH / ELECTRICAL ENGINEER

State-of-the-Art Solid-State Switch Feasibility Analysis for Pulsed Power Linear Transformer Driver Applications

While the concept of "solid-state" devices became prevalent within the 1950's – 60's, the advancement and fine-tuning of such devices have been restricted until recently due to the immense understanding of electromagnetic and quantum mechanics required. Recent innovations in the placement of P and N doping layers have led to greatly enhanced energy densities of solid-state switches. The benefits of solid-state technologies are vast and include improvements such as smaller confinement space, increased reliability, as well as quicker response times. These benefits may be implemented into a range of current and future systems such as nuclear fusion, X-Ray radiography and multiple national security concerns, however current research is tailored for use in a pulse powered Linear Transformer Driver (LTD). To determine feasibility of solid-state integration within a LTD, a MATLAB script was created which evaluates performance of four variations of solid-state technologies against the traditional spark-gap switch. Switches chosen include: IGBTs, SiC MOSFETs, PMOSFETs, and Press-Packed IGBTs. For each switch, the program runs a LTD model that returns feasible parameters upon defining load impedance. LTD parameter values are then optimized around a high pulsating current. Parameters above $1,000,000 or yielding a rise time exceeding capacitor discharge time are hence omitted. For LTD designs that need to pulse high-currents, IGBTs are found to have the greatest utility, however they have slightly slower rise-times than the MOSFETs. Coupling the current MATLAB optimization with advancements in solid-state technologies will allow for future LTD evaluations and comparisons to be quicker and more efficient.

Mentor(s): Dr. Colin Adams (Virginia Tech, AOE)

Translational Obesity Undergraduate Research Scholars

PROGRAM DESCRIPTION

The Translational Obesity Undergraduate Research Scholars (TOUR-Scholars) is a research-intensive summer experience, which prepares students for graduate and medical education in translation obesity research. Five undergraduate students from departments across Virginia Tech, along with one student from UVa, were chosen to participate in the 2017 summer program. TOUR-Scholars were matched in a translational project with two faculty mentors, working across disciplines. Funding was obtained from the Department of Human Nutrition, Foods, and Exercise, the College of Agriculture and Life Sciences, The Obesity Interdisciplinary Graduate Education Program, and the Center for Transformative Research on Health Behaviors.

PROGRAM DIRECTOR:

Dr. Deborah Good, Department of Human Nutrition, Foods, and Exercise

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COURTNEY AMOS
VIRGINIA TECH / HUMAN NUTRITION, FOODS, & EXERCISE

Do Personal Characteristics have an effect on Cooperative Extension agent willingness to participate in an interview on Intervention Dissemination?

Cooperative Extension (Extension) exists in every state and territory but little is known as to how Extension agents determine the health promotion programming to deliver within communities. As part of a larger study, agents were invited to participate in an online survey with a follow-up interview to further explore dissemination modes and adoption-decision making process. For the transferability of the qualitative data, those who participate in interviews should be representative of the target population. The purpose of this study was to investigate the representativeness of a subset of agents who participated in the qualitative portion of the study when compared to a) those who were willing to participate and did not complete the interview and b) those who were not willing to participate. Representativeness was operationalized through demographic variables: gender, ethnicity, race, role in extension, duration in extension, and highest level of education. Kruskal-Wallis tests were completed to compare significant differences by group ($p<0.05$) resulting in no significant differences ($p>0.05$) between groups. These results support that future analyses surrounding the project may be transferable across most agents delivering health promotion programming. Further testing should be conducted to investigate whether or not the methods by which the agents who completed the interviews find and share evidence-based programming differs from the agents who were unwilling to complete the interviews.

Mentor(s): Dr. Samantha Harden (Virginia Tech, Human Nutrition, Foods, & Exercise)

GRACE DAVIS
VIRGINIA TECH / HUMAN NUTRITION, FOODS, & EXERCISE

Comparing Mitochondrial Targeted Peptides and Idebenone on Complex III of the Electron Transport Chain in Damaged Mitochondria

Across many disease states the ability of the body to produce energy decreases. The majority of the body's energy is generated by mitochondria and decreased energy production can be traced to the mitochondrial electron transport chain (ETC). Several different diseases are characterized by deficiencies in the ETC, particularity at ETC Complex I, which is the largest ETC complex. The ability to bypass aberrant Complex I may increase the body's capability to produce energy, and accordingly is an area of ongoing interest for therapeutic development. In this study, we examined the ability of idebenone, a coenzyme Q mimetic, and elamipretide, a mitochondria-targeting peptide, to Complex III (CIII) of the ETC. CIII enzyme kinetics were investigated by recording the rate of reduction of Cytochrome C (CytC) using an absorbance-based plate assay. The therapeutics were added across a broad dose range (0.20uM-100uM) to determine their ability to stimulate CIII. Studies were performed in isolated heart mitochondria, as well as parallel studies without mitochondria to determine direct effects of the compound on CytC reduction. Idebenone was found to stimulate CytC in mitochondria-free preparations, while elamipretide was not different than control. Idebenone dose-dependently augmented CIII activity in mitochondrial preparations, notably when it was in its reduced (versus oxidized) form. These data suggest that idebenone may be a promising therapeutic to stimulate CIII and restore ATP production by bypassing Complex I defects in various disease states.
Mentor(s): Dr. David Brown (Virginia Tech, Human Nutrition, Foods, & Exercise)

RYAN LUPI
VIRGINIA TECH / HUMAN NUTRITION, FOODS, & EXERCISE

Human satellite cell function is regulated by autocrine secretion of IL-6 and TNF-α

Satellite cells are multipotent stem cells interwoven around muscle fibers that serve to replenish, repair, grow and maintain muscle mass as they fuse and differentiate into muscle fibers. Recently skeletal muscle has been identified an endocrine tissue secreting numerous cytokines termed myokines, including interleukin-6 (IL-6) and tumor necrosis factor-α (TNF-α, both of which may be required for proper satellite cell function. This study focuses on the patterns of autocrine release of IL-6 and TNF-α over the course of the differentiation process and how this impacts differentiation. For this study, satellite cells were cultured from 12 human subjects. Current results show proliferation and differentiation occur in a coordinated effort with IL-6 and TNF-α secretion. IL-6 increased 80% per day during proliferation ($p < 0.05$) and is blunted by differentiation, decreasing 85% after 1-day exposure to differentiation media ($p < 0.01$). TNF-α increased by 117% following exposure to differentiation media ($p < 0.01$). These events occured in tandem with the most rapid increases of fusion as demonstrated by myogenic index. During proliferation IL-6 showed a positive correlation with growth rate ($p < 0.05$), whereas TNF-α was negatively correlated. Both IL-6 and TNF-α were positively associated with reactive oxygen species production in differentiated muscle cells ($p < 0.05$). Cells with higher IL-6 secretion demonstrated more rapid proliferation but also higher oxidative stress. Future studies are needed to further discern the roles of TNF-α and IL-6 in satellite cell function and the maintenance of muscle mass in diseased patients.

Mentor(s): Dr. Matthew Hulver (Virginia Tech, Human Nutrition, Foods, & Exercise)

MINDY WEI
UNIVERSITY OF VIRGINIA / BIOLOGY

Does one size fit "all?": Exploration of the magnitude of effect of a statewide physical activity in white vs nonwhite populations

The white population in the US is generally healthier and less at risk for diseases such as obesity and hypertension. A number of interventions have been developed to target nonwhite participants, but the degree to which a program developed for and delivered to "all participants" within a state is less understood. This study aims to explore the effect of a statewide program on physical activity participation among white participants when compared to their nonwhite counterparts. FitEx is an evidence-based program that promotes physical activity in participants within an eight-week week period. The program used principles of group dynamics to encourage support and accountability and tracked each team's progress online through an interactive website. Each member of a team was invited to complete pre and post program surveys stating information including race, ethnicity, weight, miles of physical activity, and moderate-vigorous intensity physical activity (MVPA). Team members logged in to the online portal to track their daily progress of miles walked as well as fruit and vegetable intake. Of the 793 participants signed up for FitEx in 2015, 72% of the participants identified as white and 28% of the participants identified as nonwhite. Across the primary outcomes, comparing white versus nonwhite, respectively, BMI decreased (26.09±5.01 v 29.51±8.29), miles walked were similar (154.45±93.6 v 167.41±125), and percentages of participants meeting MVPA recommendations increased (66.2% v 67.8%). There were no significant differences in changes of BMI, miles walked, or MVPA change scores (p >0.05). This provides preliminary support that the program was equally effective in both white and nonwhite populations.

Mentor(s): Dr. Samantha Harden (Virginia Tech, Human Nutrition, Foods, & Exercise), Nithya Ramalingam (Virginia Tech, Human Nutrition, Foods, & Exercise)

ALEXANDRIA WRIGHT
VIRGINIA TECH / HNFE- DIET

A genetic basis for motivated exercise

The project seeks to understand the genetic basis for motivated exercise. Previous research has shown that mice containing a deletion of the basic helix-loop-helix transcription factor, Nhlh2 (N2KO mice) have lower exercise motivation than wild type (WT, normal) mice. In addition, other studies have suggested that a negative gene regulatory target of the Nhlh2 transcription factor is monoamine oxidase-A (MAO-A). MAO-A degrades monoamines such as dopamine and serotonin, which could lead to a lack of overall motivation (including the motivation to exercise). We hypothesize that N2KO mice would have higher MAO-A levels than WT mice, as we predict that Nhlh2 will act as a negative-regulator of the MAO-A gene. Using RNA and protein extracted from the hypothalamus of N2KO and WT mice, as well as mice with just one normal copy of Nhlh2 (heterozygous, HET), MAO-A protein levels will be measured by Western analysis and MAO-A RNA levels by quantitative PCR. Use of monoamine oxidase inhibitors (MAOIs), which are currently prescribed for depression, could help our current obesity epidemic, by promoting the motivation to exercise.

Mentor(s): Dr. Good (Virginia Tech, Human Nutrition, Foods, & Exercise)

NAN YANG
VIRGINIA TECH / HUMAN NUTRITION, FOOD, & EXERCISE

Excess nutrient niche negatively impacts muscle stem cell homeostasis

In patients with Type II diabetes (T2DM)/obesity, the internal microenvironment of metabolically active tissues, such as skeletal muscle deteriorated, and the patients have difficulties recovering from injury. For example, when compared to normal individuals, T2DM patients have been reported to be hospitalized for a longer period of time after muscle insults. However, the mechanism underpinning the delayed muscle recovery remains elusive. Since satellite cells (SCs), which are adult stem cells embedded in muscle fibers, are the major driver of muscle regeneration, we asked whether an obese microenvironment interferes with SC homeostasis and its contribution to muscle recovery. We hypothesized that nutrient excess negatively affects satellite cell behaviors and/or functions. To test this hypothesis, we used high-fat diet (HFD)-induced obese mice as the animal model, along with ex vivo single fiber explant culture to test satellite cell lineage progression, and in vitroì cell culture to test satellite cell proliferation, differentiation, and self-renewal. Our results showed that SCs derived from HFD muscles lost their quiescence nature in vivo, exhibited decreased proliferation and differentiation ex vivo and in vitro, and showed a reduced capability to self-renew. Taken together, these findings suggest that obesity negatively affects SC properties, which may account for the delayed muscle recovery in diabetic or obese patients. Future studies should focus on identifying the molecular mechanisms that relay the negative impacts of obesity, thereby providing the therapeutic targets for clinical intervention.

Mentor(s): Dr. David E. Gerrard (Virginia Tech, Animal Poultry Sciences), Dr. Shi Hao (Virginia Tech, Animal Poultry Sciences)

US-China Collaboration: Bats as Model Organisms for Bioinspired Engineering

PROGRAM DESCRIPTION

The IRES project is a collaborative effort among faculty members from six departments and an interdisciplinary research institute, the Institute for Critical Technology and Applied Science (ICTAS). It offers a 10-week summer research program (1 week preparation, 8 weeks research in China, 1 week wrap-up) for 5 students (undergraduate and graduate) per year. The research experiences aree hosted by the Shandong University - Virginia Tech International Laboratory that has over seven years of history as a collaborative platform for Virginia Tech and Shandong University researchers and a track record of faculty and student exchange as well as research accomplishments.

The students conduct interdisciplinary research projects located between engineering and biology, conducting engineering analyses of sensing, mobility, and control functions in bats. The projects focus on integrative aspects with the goal of elucidating how sensing, flight, and neural control in bats create the powerful synergies that enable the animals' superior performance in navigating natural environments. Each of the student projects is centered on one of the following topics: acoustical scene statistics of natural bat habitats, dynamic biosonar sensing, maneuvering flight, neural control, physiological basis of sound emission and reception.

PROGRAM DIRECTOR:

Dr. Rolf Mueller, Mechanical Engineering

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VIRGINIA TECH*, Mechanical Engineering*
Faculty Mentor: Dr. Rolf Mueller

ANDREW FARLEY
VIRGINIA TECH / MECHANICAL ENGINEERING

Design and Creation of a Platform to Compare Sonar Echoes and Stereovision

Outdoor aerial drones struggle to navigate through foliage dense forests, though bats fly through forests with ease. These bats use sonar to scan their surroundings, and maneuver accordingly. By creating a guidance system based on these bats, drones can improve their navigation through difficult environments. Interpreting the raw sonar data from artificial sonar devices can be challenging, so this data can be compared with stereovision to improve the sonar analysis. The Virginia Tech GLOBES lab has developed a sonar head system based on bats native to China. This sonar head emits ultrasonic pulses and records their echoes. It's high mobility and simple data acquisition allows for easy testing. By attaching a stereovision mount to the sonar head, the sonar analysis can be compared to a three-dimensional model. To better understand what the bats sense, all testing occurs in forests located in the Shandong province of China, the bat's natural habitat. For field uses, the stereovision was manufactured alongside the head itself by mounting together two consumer grade high-speed video cameras. The overall system was prepared to perform a static test, but it is not ready to be send into the forest for dynamic testing. Several electronic components still need to be setup to properly distribute power to each of the electronic components. This project will enable other researchers to carry out further testing, and more mobile hardware configurations. Future research may see a more complete analysis and integration of the sonar and stereovision.

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

AMAR MOHANTY

VIRGINIA TECH / MECHANICAL ENGINEERING

3D Reconstruction of the Biosonar Beampattern of the Great Roundleaf Bat (Hipposideros armiger)

Bat biosonar is characterized by beampatterns (gain as a function of direction and frequency) that have been shown to change during flight in the overall width of the beam. Furthermore, static bat biosonar beampatterns have been shown to have intricate shape features (e.g., local maxima and minima) that could be significant for the encoding of sensory information. It remains to be investigated if these local shape features can also be changed by the animal as they echolocate along the wing. To answer this question, an array setup with eight microphones has been designed to enable the 3D reconstruction of the biosonar beampattern of great roundleaf bats (Hipposideros armiger) as they fly through an flight tunnel instrumented with 32 high-speed video cameras. The challenge of this approach was that the flight tunnel has its own transfer function that has to be removed in order to reconstruct the original pulses emitted by the bat. To accomplish this, the 3d position of the bat was captured by the camera array. A loudspeaker emitting a chirp signal is then placed in the positions where the respective biosonar pulses were emitted to measure the transfer function between this position and each of the microphones. From the knowledge of these transfer functions, it should be possible to estimate the original biosonar pulses and the associated beampatterns. Suitable methods for these estimates have yet to be determined. Once this is accomplished, it should be possible to detect changes in the local shape features during biosonar tasks.

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

JOANNE TANG
VIRGINIA TECH / MECHANICAL ENGINEERING

Ear and Nose-Leaf Coordination in Roundleaf Bats (Hipposideros pratti) During Sonar Emission and Reception

Despite numerous efforts to produce powerful sonar systems, no engineered approach has replicated the capability of the biosonar system of bats. While man made sonar systems are static, the biosonar system of bats is unique in that it is dynamic due to the movement of the ear and nose-leaf. The nose emits sonar pulses which are then received by the ear, allowing the bat to navigate through the dark using echolocation. The goal of this research was to understand how a bat moves its ears and nose-leaf during pulse emission and reception which will allow for the discovery of the proper coordination of the receiver and transmitter in the creation of a dynamic sonar system. Landmark points were placed on the ear and nose-leaf of roundleaf bats (Hipposideros pratti). High speed cameras were then used to observe the movement of the ear and nose-leaf during biosonar behaviors. The nose-leaf motion patterns were classified into 4 categories: closing, opening, random vibrations, and no motion. Using a method that finds a linear combination of points that give the maximum correlation (canonical correlation), the data revealed a positive relationship between the ear and nose-leaf motions. The greatest correlation coefficient found was 0.88. Further research will identify the synchronization patterns between the nose-leaf and ear motions and investigate the functional relevance. These insights could then inform new dynamic sonar systems.

Mentor(s): Dr. Rolf Mueller (Mechanical Engineering)

MICHAEL VALOSIN
VIRGINIA TECH / AEROSPACE ENGINEERING

Flight Mechanics of Bats Drinking on the Wing

Bats are in a unique group of mammals that drink during flight instead of landing to drink. The project primarily sought to discover how the bats change flight patterns between steady, level flight and flight when drinking on the wing. Combined with previous data, the project secondarily pursued the existence of a correlation between flight patterns and bat size. To test these hypotheses, a drinking tank was placed in the bat aviary and several commercial high-speed GoPro cameras were set up out of plane with each other surrounding the tank. There were three cameras placed along the longitudinal axis of the tank, facing the sagittal plane of the bat, and one placed on the axis to see a head-on view. A customized synchronization system was employed to temporally link every camera together. The points of interest on the bat that were captured by this camera array are the nose, wrist, and fifth digit. A three-dimensional reconstruction of each point was achieved by intersecting the points found in each camera view. The points were then processed as non-dimensional amplitudes and were compared to normal flight amplitudes in order to demonstrate the difference in flight mechanics. The species of bat analyzed was the Great Roundleaf Bat (Hipposideros armiger) which has a mass of 61 g. This experiment has been previously performed with the Greater Horseshoe Bat (Rhinolophus ferrenequinum) for the purpose of comparing the two species and one of the R. ferrenequinum was dissected to find a distributed mass along the wing.

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

PETER WINDES
VIRGINIA TECH / MECHANICAL ENGINEERING

3D Motion Capture of Bat Flight Maneuvers

The flapping flight of bats is characterized by high maneuverability, load-carrying capacity, and efficiency in the low Reynolds number regime. These qualities make it an attractive model for advancing bio-inspired flight, e.g., for micro-air vehicles. A critical step in deconstructing bat flight maneuvers is experimentally capturing the movement of the bat wings in three dimensional space over time. Conventional motion capture systems are not well suited for bat flight due to high wing tip velocities, and frequent self-occlusions caused by the many degrees of freedom of the bat wings. In the present work, an array of 30 GoPro cameras (1080p resolution at 120 fps) was placed inside a 1.2-meter-wide tunnel that the bats were trained to fly through. The different viewpoints of the cameras helped to mitigate self-occlusions of the bat wings during the wing beat cycle. Large numbers of calibration images were created by video recording a laser point moving though the flight tunnel in order to determine the intrinsic and extrinsic parameters of each camera in the array. After calibration, the three-dimensional trajectories of about 200 landmarks which were placed on the bat wings were calculated. In total, approximately 50 bat flights were captured using the camera system described above. Several u-turns, 360 degree turns, climbs, and upside-down landings were captured among all the flights observed. Future work will analyze this data in two ways: using non-linear dynamics to find low-dimensional representations for the complex wing motions, and using computational fluid dynamics (CFD) to understand the aerodynamics of bat maneuvers.

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

Virginia Tech-Virginia Community College System Bridges to the Baccalaureate

PROGRAM DESCRIPTION

The Bridges to the Baccalaureate Program partners with existing programs on the Virginia Tech campus to provide experiential learning opportunities to students attending New River, Northern Virginia, or Southwest Virginia Community College. This program is funded by the National Institutes of Health (NIH) (grant number 5r25gm17749) as a means to promote diversity and inclusion in the biomedical and behavioral sciences. The program aims to increase the number of transfer students pursuing degrees and research opportunities in the biomedical and behavioral sciences. The summer research internship is a 10-week paid research experience where students work with a faculty member in a mentor/protégé relationship to conduct research and present their findings in a scholarly presentation at the end of summer. The interns also participate in academic and professional development activities and are encouraged to work towards presenting their research at a national conference.

The academic year component of the program is for newly transferred VCCS students from one of the three partnering community colleges and are known as Bridges' Scholars. These students work with a faculty mentor to conduct research and are assigned a graduate student mentor who supports them during their first year of transition at Virginia Tech. Much like the interns in the summer program, the academic year Scholars attend professional and academic enrichment workshops to further prepare them for graduate school and a career.

PROGRAM DIRECTORS:

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Dr. Kristy Collins, Biocomplexity Institute

PROGRAM + RECRUITMENT COORDINATOR:

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Virginia Tech-Virginia Community College System Bridges to the Baccalaureate

PROGRAM PARTICIPANTS *continued*

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KATELEE AVERETT

NEW RIVER COMMUNITY COLLEGE / BIOLOGICAL SCIENCES; AA

Effects of Forcefully Removing Water from the Ear Canal

When water gets lodged in the external auditory canal, most people react by quickly shaking their head to get it out. Young children and infants, however, are much more sensitive to external stimuli as they have fragile heads and necks that are not fully developed. Our goal for this research project is to find a critical acceleration required to break the surface tension of water stuck inside the ear canal, and compare it with acceleration values that cause brain damage. We used pigs as a model of the human ear; real sections of pig heads, 3D-printed models of pig ear canals, and transparent negative molds created from the 3D-printed models were used to visualize the displacement of water inside an ear canal. Preliminary results showed that the acceleration required to break the cohesion of the water was 8.4 ± 0.51 g. Such acceleration is approximately a half of the head acceleration during soccer heading or a quarter of the head acceleration to cause concussion during impact. Given this level of acceleration, young children and those who often shake their head to get water out may experience a long-term erosion of brain functionality.

Mentor(s): Dr. Sunghwan Jung (Virginia Tech, Biomedical Engineering and Mechanics)

SYDNEY CHARLES
SOUTHWEST VIRGINIA COMMUNITY COLLEGE / NUTRITION

Do Neanderthal-specific SNP's promote obesity?

Homo sapiens (Sapiens) and Homo neanderthalis (Neanderthals) have a common ancestor, but Neanderthals evolved outside of Africa, mainly in what is now known as Europe. At some point in human history, Neanderthals and Sapiens interbred, and some of the Neanderthal genome was retained in the modern-day Sapiens genome. In fact, most modern day humans, especially those of northern European descent carry up to 300 regions of Neanderthal origin. This project tested the hypothesis that single nucleotide polymorphisms (SNPs) of Neanderthal origin can be found in genes involved in body weight regulation. To do this, the Sapiens genome was compared to the known regions of the Neanderthal genome using in silico tools and databases. Neanderthal SNPs in four genes, POMC, PCSK1, MAOA and LEPR were identified, and then further characterized for the effect of the SNP on protein sequence, protein structure, and population percentages. Based on the findings for these four genes, a SNP in LEPR (the gene for leptin receptor) was chosen for further molecular analysis. Primers were designed for in vitro mutagenesis to generate the Neanderthal-specific sequence within the mouse LepR gene which is identical to humans in this region of the gene. Once this plasmid is constructed, it can be tested in neuronal cell lines to determine if the Neanderthal SNP induces a functional change in LepR protein activity. If so, then our hypothesis that Neanderthal DNA may contribute to the obesity crisis, especially in populations of European descent, will be supported.

Mentor(s): Dr. Deborah Good (Virginia Tech, Human Nutrition, Foods, & Excercise)

MATTHEW EMANUEL
VIRGINIA TECH / EXPERIMENTAL NEUROSCIENCE

Body and Soul: Assessing the effects of putative TH disruptors on body growth and schooling behavior in Xenopus laevis tadpoles.

Endocrine disruptors are chemicals, either naturally occurring or manmade, that may interfere with the body's endocrine system. Thyroid hormone is essential for normal brain development, and recent literature has suggested that certain endocrine disruptors may impact thyroid hormone signaling and compromise neural development. The Toxicology in the 21st Century program has tested a collection of more than 10,000 chemicals and have identified several putative thyroid hormone disrupting compounds, one of which is maltol, a naturally occurring compound that is used as a flavor enhancer. We are currently assessing the effects of maltol on aspects of morphological and behavioral development in Xenopus laevis tadpoles. X. laevis are useful models for assessing thyroid hormone disruption because they are acutely sensitive to shifts in thyroid hormone signaling, and their external development allows for manipulation and observation during early development that would otherwise be difficult in many mammalian systems. In order to assess the effects of maltol, individual stage 47 tadpoles (7-8 days post fertilization) were placed in one of six groups: control bath, thyroxine bath (15µg/L), and four concentrations of maltol (100µM, 300µM, 600µM, 1mM) for seven days. A stereo-microscope was used to take pictures prior to treatment and post treatment on days zero, two, four, and seven of each tadpole. Body length was measured using imageJ. Ongoing image analysis will assess if maltol induces thyroid hormone like changes. In addition, a schooling behavior experiment will assess how maltol effects behavior dependent on visual development.

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

TIFFANY FABIAN
NORTHERN VIRGINIA COMMUNITY COLLEGE NOVA

G Protein Receptors throughout Development

Astrocytes are the most numerous cell type in the human central nervous system. Once thought to simply provide structural support to the rest of the brain, it is now understood that astrocytes are integral to brain functioning. Recent RNA sequencing data obtained by our laboratory indicates astrocytes express high levels of two stimulatory, alpha subunits of the G protein coupled receptor (GPCR) family GNAS and GNA01. Stimulatory G-protein coupled receptors amplify ligand receptor binding signaling by activating cyclic AMP and subsequent downstream signaling pathways in the cell. While this signaling has been studied in neurons for nearly two decades it is unclear how these two proteins contribute to astrocyte cell development and function. To address this, we performed quantitative PCR and western blotting for GNAS and GNA01 through early postnatal development and early adulthood (Postnatal day 0- postnatal day 60) in the murine hippocampus and cortex. Ongoing studies in the laboratory are aimed at investigating astrocyte specific expression of these two GPCR subunits and potential signaling mechanisms astrocytes utilize to activate these two signaling pathways.

Mentor(s): Dr. Michelle Olsen (Virginia Tech, Biocomplexity Institute)

GARY FORTENBERRY
GEORGE MASON UNIVERSITY / BIOLOGY & CHEMISTRY

Characterization of three human lung bronchial epithelial cell lines

As new nanomaterials are introduced into consumer and medical products, the demand for predictive, effective, and realistic toxicology increases; specifically, in vitro toxicity research will advance our ability to understand the effect chemicals have on living organisms without the need for whole animal testing. Here, we conducted a characterization study on three different human lung cell lines (16HBE, BEAS2B, and A549) to determine which would be most suitable for in vitro respiratory toxicity research. Both 16HBE and BEAS2B cell lines are human bronchial epithelial cells, whereas A549 cells are adenocarcinoma human alveolar basal epithelial cells. In the future, the cells of choice will be used to investigate if/how environmental chemical exposure may affect the process of cell division. Thus, the ideal experimental system would be a cell line that performs cell division accurately. To evaluate cell division accuracy in the three cell lines, we quantified the following: mitotic timing and gross cell division abnormalities using live-cell imaging, chromosome number from metaphase spreads, and tumorigenic potential using a standard soft agar assay. This characterization study will allow the selection of the best experimental system for future cell-based toxicology studies on the effects of aerosolized nanoparticles.

Mentor(s): Dr. Daniela Cimini (Virginia Tech, Biotechnology Institue)

JEROKO GREENE
VIRGINIA TECH / PSYCHOLOGY

The moderating effect of effortful control on the association between parent-child relationship and internalizing symptomatology

The relationship between the parent and adolescent can affect internalizing symptomatology such as depression and anxiety. The purpose of this study is to consider how effortful control may moderate the effect of negativity in the parent-child relationship on adolescent internalizing symptoms. Effortful control can be defined as "the component of temperament associated with voluntary self- regulation" (Eisenberg et al., 2009). We hypothesized that more negativity in the relationship would predict higher internalizing symptomatology, but that this effect would be weaker for adolescents with better effortful control. A sample of 167 adolescents completed the Parent-Child Relationship scale, the Early Adolescent Temperament Questionnaire, and the Youth Self-Report for internalizing symptoms at Time 1 and approximately two years later at Time 3. Results indicated that higher negativity in the mother-child relationship at Time 1 predicted higher adolescent internalizing symptomatology at Time 3 (B = .19, p = .03). However, there was not a significant interaction between mother-child relationship and effortful control (B = -.04, p = .63). Alternatively, negativity in the father-child relationship was not associated with internalizing symptomatology (B = .15, p = .10) and there was no significant interaction (B = .02, p = .80). Results indicated the impact that negativity in the mother-child relationship can have on adolescent development of anxiety and depression symptoms. This effect was not moderated by effortful control, and directly targeting the quality of the mother-child relationship in prevention and intervention efforts may be more effective in reducing adolescent anxiety and depression.

Mentor(s): Dr. Jungmeen Kim-Spoon (Virginia Tech, Psychology)

KAREEM OMEISH
NORTHERN VIRGINIA COMMUNITY COLLEGE NOVA / PSYCHOLOGY

Splice variant for Foxp2 and its impacts on vocalization and behavior of juvenile rats

Foxp2 is a member of the Foxp subfamily of the Fox gene family of transcription factors. FOXP2 is the first gene to be linked to an inherited form of language and speech disorder and is expressed in areas of the brain known to be involved in language. We (i.e., Bowers and colleagues) as well as others have shown that alterations in Foxp2 influence ultrasonic vocalization in rodents. Moreover, previous research has shown a strong relationship between Foxp2 gene mutations and alterations in human language and vocalizations in animals. In order to investigate the role splice variants for Foxp2 have on neurodevelopment as well as the vocal and non-vocal associated behaviors, we overexpressed a variant of Foxp2 by use of Adeno-Associated Virus (AAV). We treated male and female rat pups at birth with the AAV via direct brain injections or a scrambled control. We recorded the vocalization of the rat pups at several ages during postnatal development. We then performed a series of behavioral tests on the rats staring at postnatal day 20 and continued to postnatal day 45. We did not detect any vocalization differences for the neonatal pup vocalizations. However, we found a basal sex difference in the social play behavior with males vocalizing more than females. More interestingly, we found both males and females with the overexpression of the Foxp2 splice variant were less social than controls. We also performed the radial arm maze to test for cognitive processing. We found the males, but not females, with the overexpressed splice variant took more time to solve the maze than control males or females. These results show that an overexpression of a splice variant form of Foxp2 impacts not only the vocal pattern or rats, but also impacts both behavior and cognitive processing. Future work in the lab is aimed at determining what proteins and mRNA are being impacted.

Mentor(s): Dr. Mike Bowers (Virginia Tech, Neuroscience)

ROBERT SMITH
NEW RIVER COMMUNITY COLLEGE / CHEMISTRY, AA

Investigating the Role of Guy1 in the Sex Determination Pathway of the Asian malaria mosquito Anopheles stephensi.

Malaria is one of many harmful mosquito-borne infectious diseases which has been reported to be the cause of 429,000 estimated deaths worldwide for the year 20153, the most recent year available. Previously used vector control strategies have significantly reduced the threat of mosquito-borne illnesses, but an increase in insecticide resistance reveals the need for novel control methods. One of the aims of vector control is to reduce the number of biting, disease-carrying, and egg-laying females. To this end the Tu lab seeks a genetic means of vector control, specifically through the investigation of sex determining genes in mosquitoes that are known vectors. Anopheles stephensi is an important vector for the spread of malaria in the Middle East and South Asia. The Tu lab previously identified a gene unique to the Y chromosome (Guy1) for A. stephensi that is expressed in the early embryonic stages of males and causes female-specific lethality in transgenic mosquito lines. In order to further investigate the biological pathway for sex determination in A. stephensi, GUY1 protein constructs were made for recombinant expression in Escherichia coli and subsequently purified using immobilized metal ion affinity chromatography. Previously produced anti-GUY1 antibodies were then tested by using western blots. Further investigation will aim to determine possible GUY1 binding partners and GUY1 target genes.

Mentor(s): Dr. Zhijian Jake Tu (Virginia Tech, Fralin Life Science Institute & Biochemistry)

MUNEEZA SYED
GEORGE MASON UNIVERSITY / CHEMISTRY, BIOCHEM & PHARMACEUTICALS

Rhodamine Release from Tailored Polymer Nanoparticles

Drug delivery has become a vital technique as people in our society tend to resort to it in times of minor to severe illnesses. A one-month study was conducted to test the hypothesis that a technique called flash nanoprecipitation (a method used to encapsulate drugs in polymeric nanoparticles with a high loading) would be more effective in making nanoparticles than currently used, double emulsion methods. Nanoparticles are solid, spherical structures that range around 1-1000 nm in size and are prepared from synthetic polymers. The purpose of this study was to increase drug loading, decrease the size of nanoparticles, and optimize the system (finding alternatives of giving less dosages of medication). Rhodamine B, a dye used as a model drug, and Poly-lactic-co-glycolic Acid (PLGA) were dissolved in Dimethyl Sulfoxide (DMSO), while Polyvinyl Alcohol (PVA – 0.3w/v%, 1.0 w/v%, 2.5 w/v%) in Deionized Water were used as the anti-solvent. The steps in creating nanoparticles included using a 2-jet mixer that created turbulent flow to make nanoparticles, dialysis followed by wash cycles and lyophilization. Rhodamine B loading was measured using UV-vis spectrophotometry, dynamic light scattering was used to measure particle size, and scanning electron microscopy was used for analyzing particle morphology. 11 batches consisting of 33 samples of nanoparticles were successfully made in this study. Percent yield was greater for the higher concentrations of PVA. However, more experiments need to be conducted to find out the appropriate weight to volume ratio to make nanoparticles that will slowly release drugs over time within the body.

Mentor(s): Dr. Johan Foster (Virginia Tech, Materials Science and Engineering)

BRANDI THOMAS
SOUTHWEST VIRGINIA COMMUNITY COLLEGE / MICROBIOLOGY

Generating a Chromosomal Gene Deletion of ompC in the Phytopathogen Pantoea stewartii

Pantoea stewartii subsp. stewartii is a Gram-negative, phytopathogenic bacterium responsible for causing Stewart's wilt disease in corn. The wilt disease produces the symptoms of water-soaked lesions in leaves and can ultimately lead to plant death due to formation of a bacterial biofilm in the xylem. P. stewartii is primarily transmitted from plant to plant by the corn flea beetle. In a previous study, Tn-Seq was used to tentatively identify genes essential for the growth of P. stewartii in planta. The Tn-Seq results need to be confirmed via generation of deletions in genes of interest and re-examination of the ability of those deletion strains to grow and cause Stewart's wilt. It has been hypothesized that one gene of interest ompC, which encodes the OmpC outer membrane protein, is essential to in planta growth of P. stewartii. Regions upstream and downstream of ompC have been amplified via the polymerase chain reaction and cloned into vectors that will enable generation of a deletion strain via homologous recombination. A copy of the ompC gene with its native promoter will be reinserted into the chromosome of the deletion strain at a neutral site to generate a complementation strain. The deletion and complementation strains will be tested in in planta assays to examine their impact on growth of the bacteria and their ability to cause disease. These efforts will help validate the results of the Tn-Seq analysis, which will provide broader insights into the P. stewartii genes that are essential for survival in the corn host.

Mentor(s): Dr. Ann M. Stevens (Virginia Tech, Biological Sciences), Duy An Duong (Virginia Tech, Biological Sciences)

VT Research and Extension Experiential Learning Program: Securing Our Food

PROGRAM DESCRIPTION

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 inaugural 2017 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. Funding was obtained through the USDA-NIFA to provide a research stipend for each of the students. This program will continue through 2020.

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PROJECT DIRECTORS:

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VT Research and Extension Experiential Learning Program: Securing Our Food

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ALLISON COOMBER
CORNELL UNIVERSITY / PLANT SCIENCE

The Relationship Between Brown Marmorated Stink Bug and Fusarium spp.

Stink bugs, including the invasive brown marmorated stink bug (BMSB) and the native brown stink bug, cause significant damage in several crops in the mid-Atlantic. Surveys of corn fields in the region have indicated that BMSB damage is associated with increased incidence of Fusarium spp. that cause grain mold and produce mycotoxins dangerous to humans and animals. As prevalence of stink bugs has increased in the region, there is a need to determine the relationship between stink bug infestations and the occurrence of mycotoxin-producing Fusarium spp. We explored the relationship between stink bugs and Fusarium, specifically focusing on the potential that stink bugs are a vector for the pathogen. Stink bugs and corn samples were collected from the same fields, and Fusarium spp. were isolated from both substrates. To compare stink bug and corn derived populations, we generated genomic tools in the form of molecular markers by bioinformatically mining publicly available genomic data for BMSB and three mycotoxin-producing Fusarium species of interest, F. verticillioides, F. proliferatum, and F. graminearum. From these datasets we identified over 1500 potential microsatellite markers. We screened these markers to develop a working set of 39. These markers were then used to genotype Fusarium populations. These results will help determine if stink bugs are shaping Fusarium movement across the agricultural landscape and provide some indication of the population genetic structure of both the pest and pathogen. Together these will inform management practices to reduce mycotoxin contamination and provide information about the biology of these pests.

Mentor(s): Dr. David Haak (Virginia Tech, PPWS), Hillary Meh (Virginia Tech, TAREC)

HARALD ELLORIN
TIDEWATER COMMUNITY COLLEGE / HORTICULTURE

Examining the biocontrol ability of rain-derived bacteria

Strains of the bacterial genus, Pantoea, are currently used in commercial bio-pesticide products. The bacteria's ability to survive and grow as well as to suppress pathogenic bacteria are key properties. With the demand for more "natural" food produced with as few chemically synthesized pesticides as possible, the numerous species of Pantoea serves as an opportunity to develop new bio-pesticide products. Due to their use in commercial bio-pesticides, we hypothesized that P. agglomerans and P. ananatis isolated from rain in Blacksburg, Virginia, would decrease the population size of pathogenic bacteria on plants and that Pantoea would grow at different rates under different field conditions. To test these hypotheses, tomato plants grown in the lab were inoculated with the potential bio-pesticide strains and, later, the pathogen. The pathogen used in this study was Pseudomonas syringae. To test the growth or survival of Pantoea in a field setting, lettuce plants were inoculated with Pantoea. One group of lettuce was grown under row cover while the others were grown without a cover. To examine the population size of bacteria from the plants, bacterial extractions were made and plated on agar plates. From this research, we found that the plants inoculated with Pantoea showed increased pathogen growth. We concluded that the Pantoea strains did not have much effect on the P. syringae. Observations and conclusions for the Pantoea survival study in the field are still in progress.

Mentor(s): Dr. Boris Vinatzer (Virginia Tech, Plant Pathology, Physiology, & Weed Science), Dr. Ramón Arancibia (Virginia Tech Eastern Shore Agricultural Research & Extension Center, Horticulture)

SUZANNE LALIBERTE
VIRGINIA TECH / BIOLOGICAL SCIENCES

Petunia as a Model for Salt Tolerance

Salt tolerance is advantageous for increased utilization of sodic soils and/or non-potable, reclaimed water for irrigation when producing crops or landscaping. Two studies were conducted with petunia, an economically important annual, to better understand gene expression when exposed to saline water and the effect of high salt soil conditions, either immediate or gradual, from sodium or a complete fertilizer. The first study consisted of transcriptomic re-analysis from a previous salt tolerance experiment. The Tuxedo protocol was used to identify genes that are expressed differentially in roots when exposed to a high concentration of NaCl in a hydroponic system at 12- and 24- hours post treatment. NCBI BLAST searches revealed that some of the differentially expressed genes included several uncharacterized genes, and a few resembled lipid transfer proteins. The second study compared growth and salt damage of plants that were sub-irrigated using a 20-20-20 complete fertilizer to petunias exposed to high salt levels. High salt treatments included a high fertilizer and a high NaCl. Two additional treatments received high salt treatments gradually in increments beginning with the control solution. The results from these two studies will be reported. This knowledge could help further the understanding of salt tolerance for the Solanaceae family.

Mentor(s): Dr. Jim Own (Virginia Tech, Horticulture), Dr. Aureliano Bombarely (Virginia Tech, Horticulture)

GABRIELLE NELSON
TIDEWATER COMMUNITY COLLEGE / HORTICULTURE

Virus-induced gene silencing in cucumber and tobacco / Nutrient uptake comparisons in terrestrial and aquatic settings

The purpose of this study is to observe phenotypes produced in cucurbits and Nicotiana benthamiana using the apple latent spherical virus (ALSV) and the phytoene desturase (PDS) gene in a virus-induced gene silencing (VIGS) system. By inoculating plants and observing subsequent phenotypes, gene functions can be further analyzed. Four cucumber seedlings and four N. benthamiana seedlings were inoculated using agroinfiltration methods. Each respective culture combined high concentrations of ALSV with one of the NbPDS, CuPDS, and GmPDS genes. The N. benthamiana inoculated with NbPDS+ALSV developed albinism, and the specimen with GmPDS+ALSV became slightly chlorotic. Alternative methods of infiltration are being considered to produce more reliable results.

This project focused on the differences in nutrient uptake by three species (Peltandra virginica arrow arum, Panicum virgatum switchgrass, and Carex stricta tussock sedge) growing in terrestrial and aquatic settings. Floating treatment wetlands are a relatively new technology used to help improve water quality by filtering and cleaning polluted runoff. Plants growing in the manmade islands act as biofilters to remove excess nutrients; primarily nitrogen and phosphorus.

The study was a randomized complete block with 3 replications. Each species was grown in sand (terrestrial) and water (aquatic) with a constant liquid feed every 12 hours at a rate of 125 ppm N (24-8-16). Growth measurements (canopy height and width) were taken every four days. The arrow arum showed the most signs of stress, while the switchgrass and sedge remained in good health. Data including pH, EC, and tissue analysis were also measured.

Mentor(s): Dr. Xiaofeng Wang (Virginia Tech, Plant Pathology, Physiology, & Weed Science), Dr. Laurie Fox (Virginia Tech, Hampton Roads Agricultural Research & Extension Center)

SAM PARK
VIRGINIA TECH / BIOCHEMISTRY

Phosphorus Solubility and Uptake with Arabidopsis thaliana

Phosphate is a limiting nutrient in agriculture. My work focuses on how plants sense and respond to phosphate and how soil amendments can increase available phosphate in soil. The first part of the project was to determine the role of two molecules, InsP6 and PPx-InsP, in the inositol phosphate (InsP) signaling pathway, in model plant Arabidopsis. The second was to examine soil amendments for their concentration of inorganic phosphate available to the plant. To address the first question, Arabidopsis mutants with altered abilities to generate InsPs were grown in conditions where total nutrients and phosphate were varied. Plants were monitored for growth rate, time to flowering and symptoms of phosphate stress. All genotypes responded to increased fertilizer by increasing growth. When assessing root growth, one mutant line was found to be phosphate insensitive suggesting InsPs are involved in response to low phosphate. Another portion of my work involved investigating phosphate availability in the field. Farmers use various soil amendments to increase the phosphate available to the plant. We tested the following for inorganic phosphate levels: fresh poultry litter (PL), a poultry litter ash produced from warm season grasses using gasification (GPLA), poultry litter ash from wood shavings and the main gasification bed (WPLA), fly ash captured from the gasification chamber air cyclone (FPLA), field soil fertilized with poultry litter (SPL), field soil without poultry litter (Soil), urea coated with FPLA, and traditional inorganic triple super phosphate (TSP) fertilizer. All sources provide inorganic phosphate for plant growth, but with varying solubility.

Mentor(s): Dr. Glenda Gillaspy (Virginia Tech, Biochemistry), Dr. Mark Reiter (Virginia Tech, Crop & Soil Environmental Sciences)

SOPHIA PINTON
VIRGINIA TECH / FOOD SCIENCE & TECHNOLOGY

Investigating the Behavior of Parasitic and Pathogenic Organisms on Vegetables

Parasitic plants can threaten crops by extracting water and nutrients from their hosts, while human pathogens can contaminate produce and harm consumer health. Experiments were conducted to examine the behavior of both parasitic and bacterial pathogens on vegetables to better understand how these organisms grow, survive and affect plant or human health. The first set of experiments focused on whether the growth of Cuscuta (dodder) varies depending on its host. Cuscuta shoots or seedling were placed on tomato, beet, or Arabidopsis hosts, and parasite growth was followed for seven days. The dry weights of the parasites and hosts were measured, but no significant differences were found in the weights of Cuscuta on varying hosts. This suggests that Cuscuta grows in a similar manner on different plants. Further studies should determine intrinsic factors of the parasite to develop parasite control strategies. The second set of experiments aimed to determine the growth and survival of Listeria monocytogenes on green beans stored at 23±2°C or 4±2°C under surface-sterilized or non-sterilized treatments. Inoculated green beans were studied at 0, 1, 2, 3, 7, and 14 days. L. monocytogenes populations increased at ambient temperatures with the largest increase occurring after one week. Long-term survival (>7d) was observed at refrigerated temperatures. No significant difference was observed among ethanol treatments, but greater visible growth on sterilized samples may be due to the lack of competition with natural microflora. Green beans are therefore potential vehicles for L. monocytogenes transmission and demand contamination prevention practices.

Mentor(s): Dr. Jim Westwood (Virginia Tech, Plant Pathology, Physiology, & Weed Science), Dr. Laura Strawn (Virginia Tech, Food Science & Technology)

LUIS SANTOS
FLORIDA STATE UNIVERSITY / BIOLOGY

The Effect of Foliar Chemicals On Two New Blackberry Cultivars: An Analysis of Leaf Metabolites, Fruit Quality, Fruit Yield, and Consumer Appeal

The increasing number of farmers planting blackberries for the purpose of pick-your-own, PYO, in Virginia has led to a need in evaluating newer cultivars that could grow profitably in Virginia's climatic conditions. One objective of this study was to evaluate two cultivars recently released by the University of Arkansas, Prime Ark Freedom and Prime Ark Traveler. Another objective was to evaluate if commercially available foliar nutrient treatments, when applied during different stages of flower and fruit development, have an effect on fruit yield, development rate, quality, and post-harvest shelf life. Foliar nutrients in this study included Sugar-Express (4-10-40), Aggrand (4-3-3), K-Ace (0-0-25), and untreated as the control. Leaf metabolite contents including chlorophyll, protein, carbohydrates, and nitrogen were determined through different bioassays. In addition, a consumer taste panel was performed to gauge consumer preferences for the varieties or treatments under evaluation. These experiments are underway and the results will be presented.

Mentor(s): Dr. Takeshi Fukao (Virginia Tech, Crop & Soil Environmental Sciences), Jayesh Samtani (Virginia Tech, Agricultural Extension & Research Centers)

HANNAH SAWYER
VIRGINIA STATE UNIVERSITY / AGRICULTURE

Effects of Rhizobacteria on Root Terpenoids in Switchgrass / Cover Crop Systems and Tilling Effects on Insect Pest and Predator Populations

Plants produce secondary metabolites, terpenes, that are known to have a defensive function benefiting plant fitness under herbivore or pathogen attack however little is known about how secondary metabolites function. Understanding the ecology and chemistry of terpenes could open the path to the creation of biological control treatments and pest resistant translational crops. Switchgrass (Panicum virgatum L.), a native prairie grass and biomass crop, was selected as the study system since its roots are rich in secondary metabolites, especially the terpenes, borneol and camphor. The quantity of camphor and borneol was analyzed in aeroponically grown switchgrass that had been inoculated with rhizosphere soil bacteria. After microbial inoculation plant roots had an increase of borneol and decrease of camphor, a chemotype practically identical to that of field grown switchgrass.

Tilling and cover cropping are farming practices that affect insect populations, namely pests and predators. Knowing the best tilling option and cover cropping system for sustaining proper predator-to-pest ratios could mean less and proper pesticide use. An abundance of pest insects can be harmful to crop growth, sustaining decent predator populations, however, can naturally keep pest numbers manageable. Farming practices that influence desired insect populations are not known. The purpose of this study was to evaluate a relationship between insect predators, pests, and these different practices. Traps were placed in multiple field plots, each treated with different cover crop mixes and tillage practices and the insects the traps collected were recorded. This experiment is still underway and results will be presented.

Mentor(s): Dr. Dorothea Tholl (Virginia Tech, Biology), Sally Taylor (Virginia Tech, Entomology)

VTCRI Molecular Visualization SURF

PROGRAM DESCRIPTION

The VTCRI Molecular Visualization SURF program is a 10-week long multidisciplinary summer program at the Virginia Tech Carilion Research Institute in Roanoke, Virginia. Seven undergraduate students participate in hypothesis-driven independent research, each under the guidance of a VTCRI faculty mentor. Students participate in a weekly workshop series to provide hands-on experience in the cutting edge imaging technologies housed within VTCRI 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. This program encompasses a full-time, 40-hour week schedule and supports Molecular Visualization SURF students with a $3,500 stipend and housing.

PROGRAM DIRECTOR:

Dr. James W. Smyth, VTCRI and VT Biological Sciences

PROGRAM PARTICIPANTS

Veronica Able-Thomas

HOLLINS UNIVERSITY, *Chemistry*
Faculty Mentor: Dr. Samy Lamouille

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ROANOKE COLLEGE, *Biochemistry*
Faculty Mentor: Dr. Konark Mukherjee

Joshua Feazell

VIRGINIA TECH, *Biology*
Faculty Mentor: Dr. Robert Gourdie

Ravin Fisher

HAMPTON UNIVERSITY, *Biology (Cellular and Molecular)*
Faculty Mentor: Dr. James W. Smyth

Momina Khan

VIRGINIA TECH, *Human Nutrition, Foods and Exercise*
Faculty Mentor: Dr. Steven Poelzing

Doug Murray

VIRGINIA TECH, *Biology*
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Alicia Yu-Shan

VIRGINIA TECH, *Microbiology*
Faculty Mentor: Dr. Ken Oestreich

VTCRI Molecular Visualization SURF

PROGRAM PARTICIPANTS *continued*

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FLORIDA STATE UNIVERSITY, *Biology*
Faculty Mentor: Dr. Takeshi Fukao

Hannah Sawyer

VIRGINIA STATE UNIVERSITY, *Agriculture*
Faculty Mentor: Dr. Dorothea Tholl

VERONICA ABLE-THOMAS
HOLLINS UNIVERSITY / CHEMISTRY

Effect of Novel Connexin43 Mimetic Peptide on Microtubule Dynamics in Glioma Stem Cells

Glioblastoma (GBM) is a lethal brain tumor accounting for the highest number of cases of all malignant brain tumors. The American brain tumor association estimates that a median survival time is 14.6 months with current treatments including surgical resection, radiotherapy and chemotherapy with temozolomide (TMZ). GBM tumors encompass a mix of cell types including glioma stem cells (GSC) which are TMZ resistant. Recent studies demonstrated that GSC TMZ resistance correlates with expression of Connexin43 (Cx43), a gap junction protein. Regulation of Cx43 localization and activity is associated with the multiple sites for protein-protein interaction within the Cx43 carboxy-terminus (CT) where a tubulin binding domain also occurs. Our previous research has found that the Cx43 mimetic peptide, JM2, which mimics the region of the CT of Cx43 that binds to tubulin, inhibits GSC migration. We hypothesize that JM2-induced inhibition in cell migration is partly due to JM2 affecting microtubule dynamics in GSCs. To test this hypothesis, we overexpressed EB1 (a microtubule associated protein) and tubulin GFP fusion proteins in GSCs and treated the cells with JM2, JM2-scrambled (a control peptide) or neither. Tracking of microtubule dynamics was then examined using confocal microscopy and analyzed using computing software. Our results show that cells expressing tubulin GFP proteins and treated with JM2 have reduced growth and higher shortening velocities than the controls, indicating that JM2 affects microtubule dynamics in GSCs. These data reveal a novel approach for targeting GSCs through alternating Cx43 function, and may contribute to the development of novel GBM therapeutics.

Mentor(s): Dr. Samy Lamouille (Virginia Tech Carilion Research Institute), Dr. James W. Smyth (Virginia Tech Carilion Research Institute & Biological Sciences)

CAITLIN DONAHUE
ROANOKE COLLEGE / BIOCHEMISTRY

Protein 4.1G interacts directly with presynaptic adhesion molecule neurexin

Proteins belonging to the 4.1 family are critical in the formation of the cytoskeleton by stabilizing the interactions between spectrin and actin proteins. Protein 4.1R in erythrocytes can bind to many proteins including band 3, glycophorins and the membrane associated guanylate kinase (MAGUK) protein P55. Neurons expresses several different 4.1 proteins including 4.1N, 4.1G and 4.1B which may play a role in synapse formation and axonal organization however the interacting molecules of these proteins are not known. It has been suggested that just like P55, the MAGUK protein CASK may interact with protein 4.1 and promote actin filamentation on the cytosolic tail of synaptic adhesion molecule neurexin. In our current study we use a fluorescent based molecular visualization technique to analyze the mechanism of interaction between protein 4.1G, neurexin and CASK. CASK and protein 4.1G are cytosolic protein, however neurexin is a membrane anchored protein. The technique is based on change in localization of CASK or protein 4.1G from cytoplasm to membrane upon co-expression of neurexin as an indicator for interaction. Our data demonstrates that even in absence of CASK, neurexin can recruit protein 4.1G to membrane indicating that they interact directly. Upon co-expression of neurexin, CASK and protein 4.1, all three proteins are localized to membrane suggesting that protein 4.1 and CASK do not compete for interaction with neurexin. Finally using a CASK mis-sense mutation deficient in neurexin binding we show that contrary to the current belief, protein 4.1 may have a higher affinity for neurexin than CASK.

Mentor(s): Dr. Konark Mukherjee (Virginia Tech Carilion Research Institute)

JOSHUA FEAZELL
VIRGINIA TECH / BIOLOGY

Distribution of Connexin 40 and NaV1.5 in the Atria

Conduction of action potentials between muscle cells in the heart has long been thought to be due to coupling mediated by gap junctions (GJs) which are clusters of intercellular channels. In previous studies we have shown that voltage gated sodium channels (VGSCs) concentrate at the edge of GJs in an adjacent specialized region of membrane called the perinexus. There has been further determination that this arrangement may enable propagation of action potential via ion transients mounted within the narrow extracellular cleft of the perinexus. Thus far, our studies have focused on the role of perinexal domains of GJs formed by connexins 43 (Cx43-GJA1) in the ventricle, which is the sole isoform expressed by this tissue. However, other myocardial tissues show expression of other connexins isoforms including Cx40 (GJA5), which is co-expressed with Cx43 in working atrial myocardium. The central questions addressed in my project are whether VGSCs associate with perinexi of GJs containing Cx40 in the atria and whether the abundance of VGSCs vary in relation to Cx40:Cx43 ratios in GJ plaques. As a first step I began immunolabeling Cx40 and Cx43 to understand the ratio and distribution within the atria via confocal microscopy. Preliminary findings suggest that larger plaques contain a higher protein density of Cx43 than Cx40. This will be further extended by examining the ratio of NaV1.5 to that of Cx40 and Cx43 labeled both independent and together. This will allow for further determination of ratios between NaV1.5, CX40, Cx43 and possible associations present.

Mentor(s): Dr. Robert Gourdie (Virginia Tech Carilion Research Institute, Center for Heart and Regenerative Medicine)

RAVIN FISHER
HAMPTON UNIVERSITY / BIOLOGY (CELLULAR & MOLECULAR)

Investigating the effect of connexin43 on adenoviral replication center maturation

Human adenovirus is a non-enveloped double stranded DNA tumor virus that causes several pathologies including respiratory, neuronal, and myocardial infections. During infection, adenovirus uncouples cell cycle regulation to induce S-phase and replicate viral DNA. E2A is a viral protein responsible for transcription that localizes to viral replication centers within the host cell nucleus. Gap junctions are structures that enable direct intercellular communication. The gap junction protein connexin43 (Cx43) is known to negatively regulate cell cycle progression yet the effect of Cx43 expression on adenoviral replication is unexplored. Given that adenovirus must uncouple cell cycle regulation in order to replicate, we hypothesized that Cx43 expression would inhibit viral replication. To test this, HaCaT cells (immortalized keratinocytes) ectopically expressing Cx43, or GW-CAT as a negative control, were infected with adenovirus type 5 (Ad5) and fixed at various time points after infection. Cells were labeled for Cx43 and Ad5 E2A using immunofluorescence for analysis by confocal microscopy. A previously published MATLAB algorithm was employed to locate and quantify E2A viral replication center maturity in individual cells based upon number, E2A area, eccentricity, and parameter. Preliminary data indicate that overexpression of Cx43 delays Ad5 replication. These findings further validate an automated approach to testing therapeutic targets in inhibition of Ad5 replication and provide insight into the role of Cx43 in cell cycle inhibition.

Mentor(s): Dr. James W. Smyth (Virginia Tech Carilion Research Institute & Biological Sciences), Patrick Calhoun (Virginia Tech Carilion Research Institute)

MOMINA KHAN
VIRGINIA TECH / HUMAN NUTRITION, FOODS & EXERCISE

Atrial Fibrillation Associated with Perinexal Expansion

For a mammalian heart to properly function it must contract as a whole, requiring it to be electrically excited. Traditionally heart cells, or myocytes communicate through gap junctions, channels that connect the cytosol of adjacent cells, causing a direct ionic transfer. However, more recently studies indicate a complementary method of electrical communication termed ephaptic coupling. Ephaptic coupling occurs in a specific, juxta-gap junction region, known as the perinexus, which is loaded with Connexin 43 (Cx43) and Nav1.5 channels. While quantifying perinexal separation is time invasive, it is unknown whether perinexal expansion remodels gap junctions. Objective: Measure perinexal width through both a manual and an automated process and how that correlates to Atrial Fibrillation (AFib), a type of arrhythmia. Perinexal width was quantified by a blinded observer from transmission electron micrographs from patients with (n=12) and without AFib (n=29). Cx43 expression in guinea pig myocardium during control, mannitol, or albumin perfusion was quantified by western blotting. Results: Perinexal width was wider in AFib relative to non-AFib patients. The method of perinexal quantification did not affect the results. This further signifies that an increase in interstitial space between the two membranes can cause disruption to ephaptic coupling. Conclusions: Atrial fibrillation is associated with perinexal expansion, but perinexal changes alone do not affect gap junction functional expression patterns. Understanding the effects of altering the region of the nexus and perinexus can lead to advancements in therapies for patients who suffer from Atrial Fibrillation.

Mentor(s): Dr. Steven Poelzing (Virginia Tech, Translational Biology, Medicine, and Health)

DOUG MURRAY
VIRGINIA TECH / BIOLOGY

Altered translation initiation limits gap junction formation during epithelial-mesenchymal transition

Cancer is the second leading cause of death in the United States. The primary cause of cancer deaths is metastasis, the invasive spread of cancer cells throughout the body. A critical step in metastasis is when tumor cells undergo epithelial-mesenchymal transition (EMT), acquiring invasive and motile properties. During EMT, epithelial cells gain such migratory ability through cytoskeletal remodeling and loss of cell-cell junctions. A cellular junction whose loss has been demonstrated as necessary for EMT to occur is the gap junction comprised of the protein connexin43 (Cx43), yet the mechanism underlying this process remains unknown. It was recently reported that Cx43 mRNA is internally translated to synthesize GJA1-20k. Internal translation is known to be inhibited by the PI3K-AKT-mTOR pathway, which is activated during EMT. We hypothesize that suppression of Cx43 mRNA internal translation is necessary for loss of gap junctions during EMT. This was tested by inducing EMT in two stable NMuMG cell lines: one transduced to constitutively express GJA1-20k and one transduced with a gene encoding for Lac Z, which acted as a control. Immunofluorescence confocal microscopy was used to evaluate whether gap junctions were lost or retained. Preliminary findings show that NMuMG cells constitutively expressing GJA1-20k retained their gap junctions as they underwent EMT while the NMuMG cells transduced with Lac Z did not retain their gap junctions, supporting our hypothesis. This knowledge may lead to the development of novel treatment options targeting internal translation initiation to limit cancer metastasis.

Mentor(s): Dr. James W. Smyth (Virginia Tech Carilion Research Institute, Biological Sciences), Carissa C. James (Virginia Tech Carilion Research Institute)

ALICIA YU-SHAN
VIRGINIA TECH / MICROBIOLOGY

Investigating Ikaros zinc finger transcription factor protein complexes by super resolution localization microscopy

T helper cells are critical mediators of adaptive immunity. Naïve helper T cells can differentiate into five subtypes (Th1, Th17, TH2, Tfh, and Treg) depending on the local environment and the cytokines present. These subsets can be distinguished by the expression of master transcription factors controlling their specific differentiation pathway. For instance, T follicular helper cells (Tfh) are discerned by the transcription factor BCL-6 (B cell lymphoma -6). Many of the mechanisms controlling BCL6 expression remain unclear. Our lab has found that three transcription factors STAT3, Aiolos and Ikaros are located at the BCL-6 promoter. STAT3 is a known transcription factor capable of enhancing the expression of BCL-6 while Aiolos and Ikaros are members of the Ikaros Zinc Finger (IkZF) family of transcription factors. Furthermore, our lab has found that STAT3 physically interacts with Aiolos by forming a transcription factor complex capable of promoting BCL-6 expression. Here, our goal is to measure and visualize the interaction between STAT3 and Aiolos employing molecular visualization techniques. We isolated TH1 cells and exposed them to a low environmental concentration of IL-2. These conditions promote the activity of STAT3 and induces a Tfh-like gene profile in TH1 cells. After differentiation, we employed super resolution localization and confocal immunofluorescence microscopy techniques to localize and measure the relationship between STAT3 and Aiolos, through Pair Correlations and Nearest Neighbor count (NNC). Deciphering the mechanisms that control BCL6 expression can potentially impact human health through the development of more effective vaccines and possible treatments for autoimmune disease.

Mentor(s): Dr. Ken Oestreich (Virginia Tech Carilion Research Institute, Immunology), Dr. James Smyth (Virginia Tech Carilion Research Institute & Biological Sciences)

VTCRI neuroSURF

PROGRAM DESCRIPTION

The VTCRI 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 the Virginia Tech Carilion Research Institute in Roanoke, VA. 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 2017 VTCRI neuroSURF fellows came from VT, the College of William and Mary, Harvard University, Christopher Newport University, Bridgewater College, and Hollins University.

PROGRAM DIRECTOR:

Dr. Michael Fox, VTCRI & VT Biological Sciences

PROGRAM PARTICIPANTS

Haley Bain

VIRGINIA TECH *Chemical Engineering*
Faculty Mentor: Dr. Konark Mukherjee

James Cole

THE COLLEGE OF WILLIAM & MARY, *Neuroscience*
Faculty Mentor: Dr. Michael Fox

George Edwards

VIRGINIA TECH, *Experimental Neuroscience*
Faculty Mentor: Dr. Stefanie Robel

Taylor Lear

VIRGINIA TECH, *Biological Sciences*
Faculty Mentor: Dr. Harald Sontheimer

Samantha Leigh

CHRISTOPHER NEWPORT UNIVERSITY, *Neuroscience*
Faculty Mentor: Dr. Stephanie DeLuca

Gabrielle Lewis

HOLLINS UNIVERSITY, *Biology*
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VIRGINIA TECH, *Neuroscience*
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Dillon Shapiro

VIRGINIA TECH, *Neuroscience*
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Kian Simpson

HARVARD UNIVERSITY, *Neurobiology*
Faculty Mentor: Dr. Brooks King-Casas

VTCRI neuroSURF

PROGRAM PARTICIPANTS *continued*

Carleigh Studtmann

BRIDGEWATER COLLEGE, *Biochemistry*
Faculty Mentor: Dr. Michael J. Friedlander

Jonathan Van Name

COLLEGE OF WILLIAM & MARY, *Neuroscience*
Faculty Mentor: Dr. Michael A. Fox

Joseph Teamer

VIRGINIA STATE UNIVERSITY, *Biology/Mathematics*
Faculty Mentor: Dr. Michael A. Fox

HALEY BAIN
VIRGINIA TECH / CHEMICAL ENGINEERING

Homo-oligomerization in X-linked intellectual disability associated CASK mis-sense mutation

Mutations in the X-linked gene CASK are associated with neurodevelopmental defects including microcephaly and intellectual disability (ID). Mis-sense mutations frequently are found in boys with variable ID and autistic traits but no microcephaly. The mechanism by which CASK mis-sense mutations produces ID in such cases remain unknown. Like all membrane associated guanylate kinase (MAGUK) proteins, CASK also harbors a src homology 3 (SH3) domain and a guanylate kinase (GuK) domain which participate in a cis intramolecular interaction. It has been demonstrated that CASK mis-sense mutations, in the vicinity of SH3 and GuK domain (W919R, Y728C) increases the propensity of CASK proteins to form aggregates, however they retain their ability to interact with physiological binding partners. In this study using transient over-expression and confocal microscopy we show that cytosolic CASKW919R aggregates recruits interacting partners such as Mint-1, Liprin-α and Protein 4.1. Surprisingly, the aggregate also recruited a physiologically non-interacting MAGUK protein called ZO-1. Recruitment of ZO-1 to CASKW919R aggregates most likely results from intermolecular interaction of SH3 domain and GuK domain between CASK and ZO-1 (domain swapping). Thus our data suggest the aggregates seen in CASKW919R are ordered homo-oligomers resulting from intermolecular domain swapping. The W919R mutation therefore is likely to produce mislocalization of CASK, its interacting partners and other MAGUK proteins via aggregation. Strikingly, overexpression of Mint-1 inhibits the formation of the oligomers. Mint1 expression occurring in later part of brain development (~E15 in mice) may thus help to stabilize CASKW919R protein, thereby limiting the severity of the associated phenotype.

Mentor(s): Dr. Konark Mukherjee (Virginia Tech, Biological Sciences)

JAMES COLE
THE COLLEGE OF WILLIAM AND MARY / NEUROSCIENCE

Perineuronal net formation has region specificity and is regulated by neuronal activity in mouse LGN

Perineuronal Nets (PNNs) are extracellular matrix structures that predominately surround subclasses of inhibitory interneurons throughout various brain regions. PNNs play a role in synaptic maturation by stabilizing axo-somatic inhibitory synapses and appear to control closing of the critical period of neural circuit formation during development. Though most previous studies have concentrated on PNNs in the cortex and hippocampus we focus our attention on the subcortical nets in the visual circuits that are essential for processing light-derived signals. Using IHC we labeled PNNs with Biotinylated Wisteria Floribunda agglutinin (Bio-WFA) and observed their prevalence in different nuclei of the lateral geniculate complex (LGN) of the thalamus. Although previous findings have shown PNNs preferentially encircle parvalbumin positive (PV+) interneurons in telencephalic regions and PV+ neurons are present in nuclei of the LGN we observed few PV+ thalamic neurons ensheathed by PNNs. Instead, other populations of neurons appear coated by PNNs in this region. Our findings also indicated a significantly reduced number of PNNs in the dLGN versus the vLGN. We likewise compared the frequency of PNNs in the vLGNs and dLGNs of genetically and surgically blinded mice and discovered a role of retinal inputs in controlling PNN formation. These results suggest PNNs are a pivotal factor in the stabilization of the connections in the visual pathway.

Mentor(s): Dr. Michael Fox (Virginia Tech Carilion Research Institute, Biological Sciences), Dr. Jianmin Su (Virginia Tech, Biological Sciences)

GEORGE EDWARDS

VIRGINIA TECH / EXPERIMENTAL NEUROSCIENCE

Does repeated Mild Traumatic Brain Injury/ Concussion affect neuronal survival in areas with loss of astrocyte function?

5.3 million Americans are living with a disability caused by traumatic brain injury (TBI). Even mild TBI (mTBI)/concussion can have long term consequences including dementia, depression, and premature death. Yet, underlying cellular mechanisms causing these have not been identified. We used a mouse model of repeated mTBI/concussion to identify cellular changes that could account for the long-term neuronal loss resulting in dementia, or other disorders.

Our preliminary data using this model showed that astrocytes, glial cells in the central nervous system, lose proteins that are crucial to maintain neuronal health in distinct areas across the brain. The goal of this research project was to assess whether neurons in these areas die.

To assess changes in neuronal densities, Aldh1l1-eGFP reporter mice, which express green fluorescent protein (GFP) in astrocytes, were injured using a weight drop paradigm. The injuries were inflicted three times, 45 minutes apart, and at a height of 50 cm. Brain tissue was collected 4 hours post initial injury (HPI), 1 day post injury (DPI), 3 DPI, 7 DPI, 14 DPI, 28 DPI and 56 DPI. Coronal sections were made using a vibratome, followed by, histological staining with antibodies against the pan-neuronal marker NeuN or Nissl. Stainings were visualized using confocal microscopy. At early and later time points we did observe neuronal presence within areas in which astrocytes lost the capability to buffer proteins important for neuronal health. However, comparatively there were no neuronal density changes within the regions of astrocyte loss to the surrounding regions.

Mentor(s): Dr. Stefanie Robel (Virginia Tech, Neuroscience; Virginia Tech Carilion Research Institute, Glial Biology Center)

TAYLOR LEAR
VIRGINIA TECH / BIOLOGICAL SCIENCES

The Influence of Acetylcholine on Glioma Migration and Invasion

Gliomas are highly invasive tumors of the brain that can cause numerous functional impairments and often times death to the patient. Gliomas have been shown to highly express nicotinic acetylcholine receptors, and it has been hypothesized that acetylcholine may have a role in their migration, which is what my research seeks to understand in order to eventually create novel therapeutic strategies to prevent this invasion/migration. The effect of acetylcholine on glioma migration was assessed using transwell migration assays and time-lapse migration assays in 3D printed chambers. Additionally, the effect of acetylcholine on matrix metalloproteinase (MMP) release was done using a DQ gelatin assay. The results of the experiments showed an increase in migration and MMP release in cells subjected to acetylcholine conditions, although the results are not statistically significant.

Mentor(s): Dr. Harald Sontheimer (Virginia Tech, Neuroscience)

SAMANTHA LEIGH
CHRISTOPHER NEWPORT UNIVERSITY / NEUROSCIENCE

Differing Levels of Upper-Extremity Constraint on Emerging Behaviors in Infants with Hemiparetic Cerebral Palsy

Pediatric Constraint-Induced Movement Therapy (P-CIMT) is a novel protocol that has proven to be efficacious in treating children with hemiparetic cerebral palsy. Traditionally, this method involves high-intensity treatment while keeping the less-impaired upper extremity (UE) in a full-arm cast in order to help the child focus on gaining functions in the more-impaired UE. However, the relationship between the type of cast and development of skills and functions in the more-impaired UE has not been explored. This study examines the efficacy of Infant-ACQUIRE, a P-CIMT method, on infants aged 6 to 18 months with three different levels of constraint: 1) a full-arm cast for most of the treatment's duration; b) a splint worn only during therapy hours; and 3) no constraint. All infants are given therapy for 3 hrs/day, 5 days/week, for 4 weeks. While we expect to see an increase in more-impaired UE functions across all participants upon completion of Infant-ACQUIRE therapy, we believe the greatest increase of these functions will occur in infants wearing the full-arm cast, as these infants will be required to direct their attention to their more-impaired UE for the entire treatment duration. The results of this study may help inform which level of constraint should be utilized for the treatment of CP in clinical settings.

Mentor(s): Dr. Stephanie DeLuca (Virginia Tech Carilion Research Institute, Neuromotor Clinic)

GABRIELLE LEWIS
HOLLINS UNIVERSITY / BIOLOGY

Protein-protein interaction between Connexin 43 and PIK3CB/p110β in glioblastoma cells

Glioblastoma is a devastating form of brain cancer with an extremely poor clinical outcome, even in the face of aggressive and prompt treatment. With a five-year survival rate of less than 5% and approximately 90% of patients having recurrent tumors within two years, glioblastoma is the most lethal form of brain cancer. Understanding how glioblastoma grows could ultimately give some clinical success to patients suffering with the disease. It was hypothesized that in glioblastoma cells expressing high levels of both the PI3K kinase protein p110β and the gap junction protein connexin 43, that p110 β interacts with connexin 43 to activate the downstream AKT pathway responsible for cell proliferation and growth. The U87MG glioblastoma cell line expresses high levels of both connexin 43 and p110 β. A co-immunoprecipitation and western blot was done with U87MG cells and confirmed an interaction between connexin 43 and p110β.

Mentor(s): Dr. Zhi Sheng (Virginia Tech Carilion)

RYAN NASSER
VIRGINIA TECH / NEUROSCIENCE

Reduction of VAChT expression has no significant impact on the NMJ

Acetylcholine (ACh) is the predominant neurotransmitter of the musculoskeletal system, an essential for contraction of all skeletal muscles. Because of its function, the level of ACh at the synaptic cleft, the region separating innervating motor axons and muscle fibers at neuromuscular junctions (NMJs), must be tightly regulated. However, the level of ACh at the NMJ is altered during aging and in a number of diseases, including amyotrophic lateral-sclerosis (ALS). This increase in ACh has been associated with accelerated degeneration of NMJs and muscle fibers during aging and in ALS. These findings indicate that reducing ACh may slow the rate of NMJ degeneration. To explore this possibility, we examined NMJs and muscle fibers in a transgenic mouse line with approximately 30% less ACh in synaptic vesicles. This mouse line, referred to as VAChTKD, expresses lower levels of the vesicular acetylcholine transporter (VAChT), which is responsible for packaging ACh into synaptic vesicles. We examined the structure of NMJs using light microscopy in developing, adult and in aged mice. In parallel, transcripts for select genes associated with the NMJ were assessed using quantitative PCR. We found no significant differences in the structural integrity of developing, adult and aging NMJs between control and VAChTKD mice. There were also no differences in levels of genes with critical functions at the NMJ between control and VAChTKD mice. Finally, we found that reducing cholinergic transmission in a mouse model for ALS, by crossing VAChTKD mice with SOD1G93A mice, does not delay ALS-related pathologies and death. These findings demonstrate that a 30% reduction in cholinergic transmission does not slow degeneration of NMJs during aging and progression of ALS.

Mentor(s): Dr. Gregorio Valdez (Virginia Tech, Biological Sciences)

KATHERINE PEREIRA
VIRGINIA TECH / CLINICAL NEUROSCIENCE

Investigating the Role of QSOX1 in Skeletal Muscles and their Synapses

The neuromuscular junction (NMJ) is the cholinergic synapse formed between a motor axon and a muscle fiber. The stability of the NMJ depends on the generation of specialized extracellular matrix (ECM), called the synaptic basal lamina (BL), separating innervating motor axons and the postsynaptic region of muscle fibers. To date, the molecules responsible for molding the synaptic BL into a complex three-dimensional structure remains unknown. We have begun to examine whether Quiescin sulfhydryl oxidase 1 (QSOX1) functions to remodel the synaptic BL as it undergoes changes throughout development, aging, or stress. QSOX1 is an enzyme shown to alter the ECM of fibroblast cells by incorporating laminin Ã_Â±4, a key component of the synaptic BL. First, we used quantitative PCR (qPCR) to determine QSOX1 levels in the tibialis anterior (TA) muscle of mice during development, aging, and following injury to the peroneal nerve, causing muscle denervation. During developemnt, QSOX1 expression is highest at post-natal day six, which is in the period when major transformation and maturation of the NMJ is initiated. As animals age, however, QSOX1 expression declines and is lowest at 24 months of age. Finally, we found that QSOX1 is upregulated as regenerating motor axons begin to reinnervate previously denervated muscles. These results show that QSOX1 increases when the NMJ is forming, and after severing adult motor axons. However, it decreases during aging as NMJs begin to fall apart. These findings indicate that QSOX1 plays important roles at the NMJ, likely by ensuring the proper formation of synaptic BL.

Mentor(s): Dr. Gregorio Valdez (Virginia Tech Carilion Research Institute, Biological Sciences)

DILLON SHAPIRO
VIRGINIA TECH / NEUROSCIENCE

Characterizing the effect of FGFBP1 on the activity of FGF's in muscle development and regeneration

The fibroblast growth factor binding protein one (FGFBP1) is known to bind and enhance the biological activity of several FGF ligands. These include FGF-1, -2, both known to promote the biogenesis of muscle fibers by promoting the proliferation of muscle satellite cells, resident stem cells. To date, it remains unknown if FGFBP1 enhance the myogenic activity of FGF-1 and -2. To explore the role of FGFBP1 in muscle biogenesis, we examined the proliferation and differentiation of the myogenic cell line, C2C12, in culture exposed to various combinations of FGF ligands with and without supplementation with FGFBP1. We also examined the effect of FGF ligands with and without FGFBP1 on myotube maturation. We then assessed the impact of deleting FGBP1 in mice on the development and regeneration of muscle fibers following injury. Our initial studies indicate that FGFBP1 increases the myogenic activity of FGF ligands in culture. We also found that loss of FGFBP1 impairs the regeneration of muscle fibers following injury. Thus, our data indicate that FGFBP1 plays a key function in the development and repair of muscle fibers by increasing the biological activity of FGF-1 and FGF-2.

Mentor(s): Dr. Gregorio Valdez (Virginia Tech, Biological Sciences),

KIAN SIMPSON
HARVARD UNIVERSITY / NEUROBIOLOGY

Trust in economic exchange for individuals with borderline

Individuals with borderline personality disorder (BPD) are known to have difficulty forming and maintaining stable interpersonal relationships. This inability to maintain stable relationships manifests itself in BPD subjects performance in an economic exchange game that involves trust (King-Casas et al, 2008). Players can entrust money to the other player in hopes that a greater sum will be returned, thus operationalizing trust as the money sent to the
opposing player.

Using principal components analysis allows the reduction of dimensionality for the game‰Ûªs behavioral data by capturing most of the variance in fewer variables. The first principle component captures high vs. low levels of trust, which somewhat differentiated controls from BPD subjects. Principal components analysis could be a useful tool in future behavioral experiments because of its ability to provide insight and simplify behavioral outcomes.

Mentor(s): Dr. Brooks King-Casas (Virginia Tech, Psychology; Virginia Tech Carilion Research Institute)

CARLEIGH STUDTMANN
BRIDGEWATER COLLEGE / BIOCHEMISTRY

Immunohistochemical Analysis of Visual Cortex in Control Rats and Rats with Mild Traumatic Brain Injury

Mild traumatic brain injury (mTBI) has been shown to alter the efficacy of neocortical synaptic connections, strengthening some circuit pathways and weakening others. The purpose of this project was to use immunohistochemistry (IHC) to investigate the effects of mTBI on the expression of specific molecular markers implicated in synaptic plasticity. At 8-9 weeks of age, Long-Evans rats underwent mTBI injury (controlled cortical impact). Two to three weeks later, mTBI and age-matched control rats were deeply anesthetized and perfused. The brain was removed and sectioned on a vibratome. Free floating sections were processed for IHC using the following antibodies: parvalbumin (PV), wisteria floribunda lectin (WFA), brain-derived neutrophic factor (BDNF), neuronal-specific nuclear protein (NeuN), ionized calcium-binding adapter molecule 1 (IBa1), glial fibrillary acidic protein (GFAP), beta amyloid (bAML) and amyloid precursor protein (APP), glutamic acid decarboxylase 67 (GAD67), calmodulin-dependent protein kinase IIa (CAMKIIa), and fluoro jade C (a histochemical stain). Labeled sections were imaged on a confocal microscope and analyzed using ImageJ. Preliminary results suggest an increase in the average mature neuron (NeuN+) soma size in TBI rats compared to control rats (p=.057). In addition, control rats might have more inhibitory interneurons (PV+) without perineuronal nets (WFA+) than TBI rats (p=.068). These results could suggest changes in inhibitory circuitry after mTBI.

Mentor(s): Dr. Friedlander (Virginia Tech Carilion Research Institute), Dr. Fischer (Virginia Tech Carilion Research Institute; Translational Neurobiology)

JONATHAN VAN NAME
COLLEGE OF WILLIAM AND MARY / NEUROSCIENCE

The role of complex retinogeniculate synapses in mouse visual behavior

Retinogeniculate (RG) synapses allow for flow of visual information from retina to primary visual cortex. RG synapses found in the mouse dorsal lateral geniculate nucleus (dLGN) differ anatomically from all other retino-recipient areas within the thalamus. The mouse dLGN contains two distinct morphologies: large RG synapses with single retinal terminal and complex RG synapses containing numerous retinal terminals that project to the same thalamic dendrite. Our lab previously discovered that Leucine-Rich Repeat Transmembrane Neuronal 1 (LRRTM1) contributes in assembling complex RG synapses in dLGN, but not in other retino-recipient nuclei. To determine role of complex RG synapses in dLGN, we performed behavioral tests on LRRTM1 knockout mice (Lrrtm1-/-). To test for pattern discrimination and visual acuity, we assembled a visual water box consisting of a trapezoidal-shaped pool and midline divider. The longer ends of the box contained computer monitor for presentation of visual stimuli, and a hidden escape platform was placed under one of the ends. Based on the accuracy of visually-directed decisions, Lrrtm1-/- and control mice performed similarly when discriminating between vertical pattern and gray screen. We then changed the paradigm so that mice had to determine complex vertical and horizontal patterns. This study revealed that control mice consistently outperformed Lrrtm1-/- mice by the end of training. As we conducted further tests by varying pattern frequency and contrast, we found that Lrrtm1-/- mice continued to perform poorly compared to controls, suggesting that complex RG synapses are crucial for relaying more complex visual signals from retina to the brain.

Mentor(s): Dr. Michael A. Fox (Virginia Tech Carilion Research Institute), Aboozar Monavarfeshani (Biological Sciences)

JOSEPH TEAMER
VIRGINIA STATE UNIVERSITY / BIOLOGY,MATHEMATICS

Toxoplasma gondii-induced activated microglia cells contribute to the hippocampal inhibition of axosomatic synapses.

Toxoplasma gondii is a parasitic protozoan that is capable of infecting most warm-blooded animals when it resides in distinct tissues including the brain and skeletal muscles. Nearly, one-third of the US population is infected by Toxoplasma gondii, largely through consumption of improperly cooked meat. In its active stage, Toxoplasma gondii causes a disease known as Toxoplasmosis, which has been linked to the inflammation and activation of microglia, resident immune cells in the brain that lead to phagocytosis and synaptic deterioration in several models of inflammation and neurotrauma. Recently, Brooks et al. (2015) revealed a reduction in the number of inhibitory GABAergic synapses in mice infected with the type2 strain, ME49. Here, we investigated how Me49 parasite-induced activation of microglia may contribute to the loss of hippocampal inhibitory axosomatic synapses. Upregulation of microglia surrounding the nuclei of neuronal cells were seen in Toxoplasma gondii-infected mice compared to mock-infected mice. Using Serial Block Face Scanning Electron Microscopy (SBFSEM) tissue datasets, we analyzed the ultrastructural morphology of microglia, neurons, and inhibitory synapses in the hippocampus of these mice. The data showed that microglia proliferation in infected brains results in stripping of axosomatic synapses and a subsequent increase in the surface area of neurons unsheathed by microglia processes, therefore inhibiting synaptogenesis. With a high prevalence in the human population, Toxoplasma gondii has been linked to several psychiatric and neurodegenerative diseases that stem from synapse loss. Therefore, the results in this project set the framework mechanism underlying neural circuit change in Toxoplasma gondii infected humans.

Mentor(s): Dr. Michael Fox (Virginia Tech Carilion Research Institute), Gabriela Carrillo (Virginia Tech Carilion Research Institute)