OFFICE OF
UNDERGRADUATE
RESEARCH

2019 Dennis Dean Undergraduate Research & Creative Scholarship Conference

MOSS ARTS CENTER

APRIL 19, 2019

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Welcome

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

Welcome to Virginia Tech's Spring Undergraduate Research and Creative Scholarship Symposium. This event is a celebration of the creative and scholarly accomplishments of undergraduate students campus-wide. Our program features the work of students from 69 different academic programs in all academic colleges, reflecting the quality and diversity of undergraduate research at Virginia Tech. Many of the projects are the result of collaborations among several students. We are also pleased to welcome area high school students who have conducted research with Virginia Tech faculty.

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

An event such as this requires tremendous behind-the-scenes support. I am most grateful to Keri Swaby, University Undergraduate Research Coordinator, for her leadership in organizing and executing today's conference. Keri was well supported by Nicole Easton, Janet Hilder, and Alexa Keeler.

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

Enjoy!

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

Office of Undergraduate Research

Keri Swaby
University
Undergraduate
Research
Coordinator

Welcome to the annual Undergraduate Research and Creative Scholarship conference at Virginia Tech! This day-long event will showcase the breadth of research and creative scholarship taking place across campus every day at Virginia Tech and will demonstrate how broadly we define this impactful form of experiential learning. Presenting results of a research or creative project is an important part of a student's overall journey because it provides them with the opportunity to learn to effectively communicate to a broad audience, defend their work, exchange ideas, and even be inspired for future research. Thank you for being here and helping our students to grow.

I am particularly excited about this year's plenary event, which brings three incredible alumni back to campus to share their research stories and offer perspectives on where these experiences have helped to take them beyond graduation. I hope you will join me to hear Carrie, Dorian, and Trevor share their stories of gaming and mosquitoes and tornadoes… oh my!

Critical to the success of the OUR this year has been the hard work of our new Program Assistant, Nicole Easton, and graduate student, Janet Hilder, who sadly (for us) graduates in May; the guidance of an active 16-member advisory board, comprised of faculty, administrators, and undergraduate and graduate students; and the 15 amazing Ambassadors who tirelessly work to help students get involved with undergraduate research. Without these dedicated people, the operations of the OUR would not be possible. I would also like to say 'thank you' to the Fralin Life Science Institute, whose continued financial support allows us to celebrate undergraduate research and creative scholarship here today.

I am humbled by the quality of work on show as part of this symposium and invite you to marvel at the wealth of research and creative scholarship the university has to offer. I invite you all to engage, to explore, to connect, and to have fun!

Keri Swaby
University Undergraduate
Research Coordinator

Keynote Session Speakers

Oh the Places You Will Go! We are delighted to have, as a featured part of this year's conference, three distinguished Virginia Tech and Office of Undergraduate Research alumni serving as panelists for a keynote presentation. Panelists will share information about their time at Virginia Tech and how research has impacted their current work and career paths.

Please join us for this special session.

CARRIE DAY, Video Game Designer | BA, Chemistry ('15)

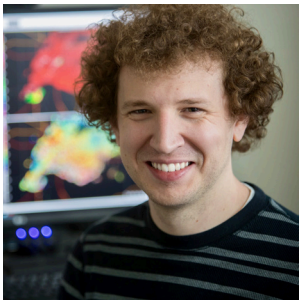
Since earning a BA in Chemistry with a minor in Scieneering from Virginia Tech in 2015, Carrie went on to Tenneesee Tech, where she is currnetly pursuing a BS in Computer Science.

She has worked as a Twitch Streamer/Gamer, Associate Gameplay Designer: Combat at Zenimax Online Studios, and Digital Access and Discovery Specialist at Tennesee Tech Libraries.

DORIAN JACKSON, Mosquito Whisperer | BA, Biology ('15)

Since earning a BA in Biology with a minor in Entomology from Virginia Tech in 2015, Dorian went on to UC-Berkeley, where he graduated with an MPH in Infectious Diseases and Vaccinology in 2017.

He is currently pursuing a PhD in Molecular Microbiology and Immunology at Johns Hopkins School of Public Health.



TREVOR WHITE,Tornado Scientist | BS, BIT ('14); MS, Geography ('16)

Since earning a BS in Business Information Technology with a minor in scieneering from Virginia Tech in 2014, Trevor went on to complete an MS in Geography in 2016 from Virginia Tech.

He previously worked as a developer at AVEC Engineering. He now lives in Boulder, CO, and works as an Associate Scientist at the Center for Severe Weather Research.

Thank you . . .

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

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Schedule at-a-glance

8:30am	Check-In Opens	FIRST FLOOR LOBBY
8:30-9:05am	Session 1 Set-Up	FIFE THEATER STAGE
9:05-9:55am	Session 1	FIFE THEATER STAGE
9:55-10:10am	Break Session 1 take-down/Session 2 set-up	
10:10-11:00am	Session 2	FIFE THEATER STAGE
11:00-11:10am	Break Session 2 take-down/Session 3 set-up	
11:10am-12:15pm	Keynote Event	FIFE THEATER
11:30am-1:30pm	Lunch (provided for presenters)	SECOND FLOOR LOBBY
12:20-1:10pm	Session 3	FIFE THEATER STAGE
1:10-1:25pm	Break Session 3 take-down/Session 4 set-up	
1:25-2:15pm	Session 4	FIFE THEATER STAGE
2:15-2:30pm	Break Session 4 take-down/Session 5 set-up	
2:30-3:20pm	Session 5	FIFE THEATER STAGE
3:20-4:00pm	Break Session 5 take-down/Session 6 set-up	
4:00-4:50pm	Session 6	FIFE THEATER STAGE
4:50pm	End of symposium/Session 6 take-down	

Session 1 9:05-9:55AM

E1	Jill I. Grzelak (Biological Systems Engineering) FUTURE CLIMATE CHANGE PROJECTIONS IN VIRGINIA
E2	P'trice R. Jones (Psychology) EXAMINING THE RELATIONSHIP BETWEEN POLICE LABELS AND POLICE CONFIDENCE
E3	Kirat K. Pandher (Architecture) STUDYING BUILDING ENVELOPE THROUGH THE WORKS OF TWO INDIAN ARCHITECTS
1	Michael W. Chen (High School Student) THE ROLE OF EPHA4 IN VASCULAR GENE INFLAMMATION
2	Sophia R. Link (Blacksburg High School Student) THE ROLE OF THE IPK1 AND ITPK1 GENES IN PLANT SUCROSE SENSING
3	Claire M. Morton (Blacksburg High School Student) THE RELATIONSHIP BETWEEN CODON USAGE BIAS, MRNA HALF-LIFE, AND THE STE13 PROTEIN
4	Erod Keaton D. Baybay (Physics) UNPACKING THE Z-STACK: VOLUMETRIC WHOLE-CELL AND NUCLEAR FITS FOR IMAGE ANALYSIS OF LOCALIZED FLUOROPHORES IN FISSION YEAST
5	Ethan D. Boeding (Nanoscience) QUANTIFYING NUCLEIC ACID ASSOCIATION TO NANOPARTICLES
6	Nicole M. DeFoor (Computational & Systems Neuroscience) SYNTHETIC SPEECH AND ITS EFFECTS OF HUMAN TRUST
7	Tanner G. DeHart (Biochemistry) CHARACTERIZATION OF PENICILLIN BINDING PROTEIN 2A IN BORRELIA BURGDORFERI, THE CAUSATIVE AGENT OF LYME DISEASE
8	Kristina East (Biomedical Sciences) ENGINEERING A BIOMIMETIC TUMOR MICROENVIRONMENT TO STUDY PATIENT-DERIVED CELL INTERACTIONS IN VITRO
9	Clara L. Frazier (Biochemistry) A PROTEOMICS APPROACH TO QUANTIFYING VITELLOGENIN IN THE EASTERN HELLBENDER (CRYPTOBRANCHUS ALLEGANIENSIS)
10	Hailey Groff (Clinical Neuroscience) TONGUE ANATOMICAL MODEL, THROUGH THE PROCESS

Session 1 (continued)

11 **Courtney R. Linkous** (Wildlife Conservation)
VEGETATION CHOICE FOR NEST-SITE SELECTION OF SONG SPARROWS AMONG RURAL AND URBAN HABITATS

12 **Scott T. Mcguigan** (Chemistry)
ELECTROCHROMIC TUNGSTEN OXIDE THIN FILMS FOR DYNAMIC GLASS UTILIZING INTERCALATING CHEMISTRY

13 **Elieser A. Mejia** (Electrical Engineering)
FABRICATION OF TRANSPARENT NANOHOLE ARRAY TEMPLATES FOR MULTI-LAYER THIN FILM DEPOSITION

14 **Madison E. Nardi** (Animal & Poultry Sciences)
THE EFFECTS OF ZINC SUPPLEMENTATION ON IN VITRO BOVINE EMBRYO DEVELOPMENT

15 **Hayley E. Oliver** (English Literature)
SELFHOOD, SOULFULNESS, AND SEXUALITY IN ZORA NEALE HURSTON'S THEIR EYES WERE WATCHING GOD

16 **Mika K. Pagani** (Environmental Science)
HALYOMORPHA HALYS FEEDING IMPACT ON INDUSTRIAL HEMP YIELD AND QUALITY

17 **Gabby C. Puller** (Biological Sciences)
EVIDENCE FOR CONNECTIONS BETWEEN FLAVONOID METABOLISM AND THE CIRCADIAN CLOCK IN ARABIDOPSIS THALIANA

18 **Amber R. Reaney** (Microbiology)
PERSISTENCE OF ANTIMICROBIAL ACTIVITY IN OYSTER MUSHROOM HERBARIUM SPECIMENS

19 **Alexandra D. Russell** (Mining Engineering)
CHARACTERIZATION OF RARE EARTH ELEMENTS IN FINE COAL REFUSE AS A FUNCTION OF SIZE USING ULTRAFINE SIZE CLASSES

20 **Michael R. Santos** (Biological Sciences)
MICROFLUIDIC PLATFORM TO QUANTIFY SINGLE-CELL CIRCADIAN RHYTHMS

21 **Wenting Shi** (Chemical Engineering)
DEVELOPMENT OF DRUG-LOADED OPTICAL FIBERS FOR CANCER THERAPY

22 **Alex D. Simon** (Engineering Science & Mechanics)
THERMALLY-ENHANCED HISTOTRIPSY FOR THE NON-INVASIVE ABLATION OF FIBROUS TUMORS

Session 1 (continued)

23 Sophia D. Textoris (Human Development)
EXAMINING SIBLING EXPERIENCES IN FAMILIES OF INDIVIDUALS WITH MENTAL ILLNESS

24 Matthew L. Trible (Agricultural Technology)
GILES LAND LAB FORAGE IMPROVEMENT

25 Brian K. Yoon (Biology)
PREDICTING BASELINE PHYSIOLOGICAL TRAIT VALUES FOR DATA DEFICIENT SPECIES USING EVOLUTIONARY MODELS

26 Rachael E. Ward (Experimental Neuroscience)
EPHA4 IS A NOVEL MEDIATOR OF BLOOD-BRAIN BARRIER BREAKDOWN FOLLOWING TRAUMATIC BRAIN INJURY

27 Gabriel M. Coleman (Neuroscience)
EPHA4 IS NOVEL MEDIATOR OF NEUROINFLAMMATION AND TISSUE LOSS FOLLOWING TRAUMATIC BRAIN INJURY

Session 2 10:10-11:00AM

E1 **Kayla B. Carey** (Animal & Poultry Science)
UNDERSTANDING THE IMPACT OF ASCORBIC ACID ON IN VITRO-DERIVED PORCINE EMBRYOS DURING PREIMPLANTATION DEVELOPMENT

E2 **Tabitha K. Parks** (Dietetics)
FTO GENE AND EFFECTS ON OBESITY RISK

E3 **Ainsley K. Patrick** (Psychology)
SLEEP DIFFICULTIES IN YOUTH WITH SPECIFIC PHOBIA

1 **Caroline Flynn** (Creative Technologies in Music)
PULLING AT THE HEARTSTRINGS

2 **Abigail M. Bock** (General Engineering)
DEVELOPMENT OF 3D-SACRIFICIAL ENVIRONMENTS TO STUDY TUMOR GROWTH AND INVASION

3 **Kedi Cao** (Systems Biology)
MATHEMATICAL MODELING OF PER2-P53-MDM2 NETWORK DYNAMICS

4 **Emily R. Clifford** (Cognitive Neuroscience)
PARENT STRESS AND CHILDHOOD AGGRESSION IN CHILDREN WITH AUTISM SPECTRUM DISORDER

5 **Brenna V. DeBellas** (Biological Sciences)
DISCOVERY OF A RECENTLY DESCRIBED MOBILE ELEMENT IN NOVEL MYCOBACTERIOPHAGE CAMRI

6 **Darren T. Dougharty** (Biochemistry)
HUMAN TAU ISOFORM AGGREGATION AND USING AGGREGATED TAU ISOFORMS AS NEW BIOMARKERS FOR ALZHEIMER'S DISEASE DETECTION

7 **Sally R. Dukes** (Political Science)
SHEPPARD V. MAXWELL REVISTED

8 **Thomas N. Hale** (Political Science)
DECODING CHINA-PAKISTAN ECONOMIC CORRIDOR (CPEC) MESSAGING: A REALITY CHECK

9 **Sarah L. Heine** (Human Nuritrion, Foods, & Exercise)
VITAMIN D RECEPTOR: RS2228570

10 **Jacob S. Helmann** (Biology)
EXPLORING DISPERSAL AND GENETIC CONNECTIVITY THROUGH A NEWLY DISCOVERED ARIZONA TREEFROG POPULATION

11 **Dexter W. Howard** (Water: Resources, Policy, & Management)
IDENTIFYING THE DRIVERS OF ORGANIC CARBON IN DRINKING WATER RESERVOIRS TO IMPROVE WATER QUALITY

Session 2 (continued)

12 **Harley D. Huffman** (Sociology)
REMINISCING ON A PROVERB "KILL YOUR HEROES": RE-IMAGINING THEORY IN THE 21ST-CENTURY AND DISMANTLING THE LOGIC OF PRACTICE THROUGH THE WAYS OF LIMINALITY

13 **Grant E. Kawecki** (Biochemistry)
INSIGHT INTO AMYLOID INTERACTIONS: MOLECULAR DYNAMICS SIMULATIONS OF MODEL PEPTIDE FRAGMENTS

14 **Rebekah Klewicki** (Human Nuritrion, Foods, & Exercise)
THE COLLABORATIVE PROCESS OF CREATING A 2-D MODEL OF THE PITUITARY GLAND

15 **Twyla T. Lee** (Biochemistry)
THE ROLE OF KIR4.1 IN THE DEVELOPMENT OF EPILEPSY

16 **Audrey C. Morris** (Agriculture Science)
VIRGINIA COOPERATIVE EXTENSION INTERNSHIP: BEST PRACTICES

17 **Julie T. Nguyen** (Physics)
PHASE TRANSITIONS IN DMPC/DSPC MIXTURES

18 **Madeleine C. Paulsen** (Cognitive & Behavioral Neuroscience)
HOW CAN A WEBSITE INCREASE USER ENGAGEMENT? A COMPREHENSIVE STUDY OF THE RELATIVE INFLUENCE OF MULTIMEDIA DESIGN

19 **Aubrey N. Phares** (Cognitive & Behavioral Neuroscience)
WHAT EXPRESSIONS OF ANXIETY ARE MOST PREVALENT AMONG INDIVIDUALS WITH AUTISM SPECTRUM DISORDER?

20 **Rachel L. Phillips** (Human Development)
CHILD EMOTION REGULATION: CONTRIBUTIONS OF PARENTAL EMOTION COACHING

21 **Nikita A. Pike** (Clinical Neuroscience)
HOW INDIVIDUAL RATINGS OF TEAM COHESION CHANGE OVER TIME

22 **Blake Roberts** (Landscape Architecture)
SCIOTO RIVER METRO PARK AND ECOLOGIC CENTER

23 **Lauren M. Strickland** (Biological Sciences)
THE EFFECT OF VARIOUS SYMBIONT LOADS ON CRAYFISH BEHAVIOR

24 **Rhiannon K. Takemoto-Jennings** (Psychology)
PEDESTRIAN-VEHICLE COMMUNICATION AT CROSSWALKS: INTERVENING TO INCREASE THE RATE OF PEDESTRIAN GRATITUDE

Session 2 (continued)

25 **Janay A. White** (Business Information Technology)
SAFETY CONCERNS IN ELDERLY PRODUCTS

26 **Matthew J. Kile** (Mechanical Engineering)
PROGRAMS FOR MECHANICAL BEHAVIOR ANALYSIS FOR INTELLIGENT DESIGN OF ARCHITECTED MATERIALS

27 **Sydney Buck** (Construction Engineering & Management)
THE IMPACT OF INTERNATIONAL SERVICE-LEARNING PROJECTS ON STUDENTS' ENGINEERING EDUCATION

Session 3 12:20-1:10PM

1 **Ankit Malhotra** (Computer Engineering)
TECHSMITH

2 **Amber R. N. Abbott** (Microbiology)
RET SIGNALING IN HERPES SIMPLEX VIRUS LATENCY AND REACTIVATION

3 **Ossam A. Awan** (Biology)
IMAGE ANALYSIS AND QUANTIFICATION OF BACTERIAL FILAMENT MOTILITY IN CLOSTRIDIUM PERFRINGENS

4 **Carl Chalk** (Physics)
ROCKET CONSTRUCTION PROJECT

5 **Tanner J. Dean** (Biochemistry)
STRUCTURE AND DYNAMICS OF C-MYC G-QUADRUPLEX

6 **Camille T. Do** (Geosciences)
CORRELATION OF INORGANIC CARBON AND NITROGEN ISOTOPES IN THE EDIACARAN SEDIMENTARY BASINS

7 **Sofia M. Ghani** (Human Nutrition, Foods, & Exercise)
DO THOSE CARRYING THE VARIANT GENOTYPE OF RS12970134 ON THE MELANOCORPIN 4-RECEPTOR GENE HAVE A HIGHER BMI?

8 **Julia N. Goyer** (Materials Science & Engineering)
EXPLORING SOLVENT MIXTURES AND PARTICLE INTERACTIONS FOR NEAR-NET SHAPING OF ULTRA HIGH TEMPERATURE CERAMICS

9 **Bethany K. Grocock** (Human Development)
INFORMATION SEEKING FROM HUMAN, PRINTED, AND DIGITAL SOURCES

10 **Elizabeth G. Hayes** (CSNU)
EXAMINING THE EFFECTS OF MUTATIONS OF AMYLOID BETA(Aî²) ON NEURODEGENERATIVE DISEASE PATHOLOGY USING MOLECULAR DYNAMICS (MD) SIMULATIONS

11 **Sierra J. Hennessy** (Psychology)
EXPLORING PARENT STRESS AND RESTRICTED REPETITIVE BEHAVIORS IN ASD

12 **Connor Herron** (Mechanical Engineering)
LOW LEVEL CONTROLLER HARDWARE & SOFTWARE DESIGN AND IMPLEMENTATION FOR A ROBOTIC HUMANOID LEG

Session 3 (continued)

13 **Sofia E. Hirt** (Psychology)
COGNITIVE COMPLEXITY AND INTERNALIZING SYMPTOMS IN ADOLESCENCE: MODERATION BY ADOLESCENT SEX

14 **Sara Honaker** (Biochemistry)
GEIGER COUNTER

15 **Bridget Kastelberg** (Systems Biology)
GLOBAL CHARACTERIZATION OF IMMUNE RESPONSES BY DENDRITIC CELLS IN RESPONSE TO A. FUMIGATUS VIABLE CONIDIA

16 **Jiwoo Kim** (Biochemistry)
RECEPTOR STABILITY IN SINORHIZHOBIUM MELILOTI ALTERING PUTATIVE PROTEOLYSIS SITES

17 **Emily Maher** (Multimedia Journalism)
PICTURING TRAILS: APPLICATION FOR STORYBOARD CREATION

18 **Tushar Malik** (Economics)
THE CYCLE OF SURVEILLANCE

19 **Kelsey McMahon** (Sociology)
EFFECTS OF ADULT PRISONS ON JUVENILE DELINQUENTS

20 **Caitlin A. Miller** (Wildlife Conservation)
DISSOLVED ORGANIC CARBON UPTAKE BY MICROBES IN A STREAM CONFLUENCE MIXING ZONE

21 **Douglas W. Murray** (Biology)
INVESTIGATING DIFFERENCES IN PRB BINDING AFFINITY BETWEEN MADV1 AND MADV3 E1A USING SURFACE PLASMON RESONANCE (SPR)

22 **Lynda Nguyen** (CMDA)
RATING AND RANKINGS OF BASKETBALL TEAMS

23 **Erin R. Quesenberry** (Wildlife Conservation)
USING THE VIRGINIA TECH CAMPUS AS A LABORATORY FOR ASSESSING DISPERSAL PATTERNS AND BIASES IN LAND PLANTS

24 **Jacob E. Riney** (Computer Science)
RECONSTRUCTING CLIMATE CHANGE RESPONSES OF THE FERN GENUS CRYPTOGRAMMA FROM THE LAST GLACIAL MAXIMUM AND ONWARDS

25 **Wendi E. Williams** (Biochemistry)
CAN ANAPHASE BE SIMPLIFIED BY BYPASSING SEPARASE?

Session 3 (continued)

26	Eric D. Wuerfel (Physics) CHIRPLAB: ALTERNATIVE FILTERING METHODS IN GRAVITATIONAL WAVE ASTRONOMY
27	Trevor Nier (Mechanical Engineering) THE EFFECT OF ALIGNED POLYETHYLENE OXIDE (PEO) NANOFIBER COATING ON URETERAL STENTS TO COMBAT MICROBIAL ADHESION

Session 4 1:25-2:15PM

E1 **Adrian Ridings** (Biochemistry)
ACCESSIBILITY OF MENTAL HEALTH CARE TO QUEER AND TRANSGENDER STUDENTS

E2 **Sadye E. Soffin** (Animal & Poultry Sciences)
THE EFFECTS OF SUPPLEMENTING POLYUNSATURATED FATTY ACIDS ON BOVINE CT1 CELL TRANSCRIPT EXPRESSION

E3 **Robert B. Shelton** (Industrial & Systems Engineering)
BIOMASS FEEDSTOCK LOGISTICS

1 **Alvin Aung** (Mechanical Engineering)
INVESTIGATION OF PHASE SEPARATION OF MOTILE AND NON-MOTILE POPULATIONS IN MICROBIAL COMMUNITIES

2 **Melissa Barnes** (Animal & Poultry Sciences)
PREVENTING IRON DEFICIENCY ANEMIA IN PIGS FED ANTIBIOTIC-FREE DIETS CONTAINING HIGH COPPER LEVELS

3 **Laura C. Beaudet** (Psychology)
WILLIAMS SYNDROME SIBLING SURVEY

4 **Colleen P. Chrisman** (Mathematics)
GENDER INEQUITY IN HIGH STAKES CINEMATIC ACHIEVEMENT AWARDS

5 **Shubham A. Dawda** (Electrical Engineering)
QUANTITATIVE PHASE IMAGING OF CELLULAR RESPONSE TO ELECTRICAL FIELD

6 **Ava DiVita** (Environmental Science)
MECHANICAL HARMING EFFECTS ON MUTANT VERSUS WILD TYPE ARABIDOPSIS PLANTS FOR GENE FUNCTION DETERMINATION

7 **Hannah-Marie S. Eddins** (Animal & Poultry Sciences)
FIRST DESCRIPTION OF THE HAND AND FOOT OF A DERIVED PHYTOSAUR FROM THE CHINLE FORMATION OF NEW MEXICO

8 **Annie L. Eick** (Psychology)
THE ACTIVELY CARING FOR PEOPLE (AC4P) MOVEMENT: APPLYING BEHAVIORAL SCIENCE TO IMPROVE POLICE-CITIZEN RELATIONS

9 **Hannah M. Flavin** (Psychology)
THE IMPACT OF DAILY TECHNOLOGY USE ON PSYCHOLOGICAL HEALTH AND WELL-BEING: A MULTI-LEVEL APPROACH

Session 4 (continued)

10 **Sarah E. Hack** (Industrial & Systems Engineering)
ADOLESCENT RISK NATURALIST DRIVING STUDY

11 **Mariama D. Kabore** (Microbiology)
INVESTIGATION OF MOTF INTERACTION WITH MOTA OF THE SINORHIZOBIUM MELILOTI FLAGELLAR MOTOR

12 **Nina S. Kappel** (Wildlife Conservation)
EXAMINING PREDATOR AVOIDANCE BEHAVIORS IN WHITE-TAILED DEER IN NORTHERN FLORIDA

13 **Julia A. Kawas** (Physics)
MODELING THE PATHOGENESIS OF HUMAN ADENOVIRAL MYOCARDITIS IN INDUCED PLURIPOTENT STEM CELL-DERIVED CARDIOMYOCYTES

14 **Zichen Liu** (Landscape Architecture)
"SHAN-SHUI": A FRAMEWORK FOR URBAN EXPANSION WITHIN A MOUNTAIN AND WATER LANDSCAPE

15 **Jessica E. Marino** (Human Nutrition, Foods, & Exercise)
IS THERE A CORRELATION BETWEEN THE MONOAMINE OXIDASE A GENE AND THE MOTIVATION TO EXERCISE IN STUDENT VOLUNTEERS FROM VIRGINIA TECH?

16 **Caitlin M. McCaughan** (Biological Sciences)
TETRODOTOXIN RESISTANCE OF NAV 1.8 IN SNAKES THAT CONSUME TOXIC NEWTS

17 **Lindsey E. McClain** (Human Nutrition, Foods, & Exercise)
GENOTYPE AND PHENOTYPE ANALYSIS OF MTHFR POLYMORPHISMS IN VIRGINIA TECH STUDENTS

18 **Allen W. Milby** (Wildlife Conservation)
HOW DISTURBANCE HISTORY AFFECTS LICHEN AND BRYOPHYTE DIVERSITY IN TWO ON-CAMPUS OLD GROWTH FORESTS

19 **Jonathon M. Monroe** (Biological Sciences)
THE EFFECTS OF SPATIAL AND TEMPORAL HYDROLOGIC VARIATION ON MICROBIAL CARBON-SUBSTRATE METABOLIC DIVERSITY

20 **Tyler Ricks** (Animal & Poultry Science)
2D ANATOMICAL MODEL OF A BOVINE HEART

21 **Marilyn J. Steinbach** (Biology)
POSTTRAUMATIC STRESS DISORDER VULNERABILITY IN WOMEN: THE NEUROPSYCHOLOGICAL IMPACT OF EMOTIONAL TRAUMA FROM RAPE

Session 4 (continued)

22	Morgan C. Stephens (Biology) NONCANONICAL NF- _B SIGNALING IS UPREGULATED IN IBD PATIENTS AND CONTRIBUTES TO DECREASED ANTI-TNF TREATMENT RESPONSE
23	Annelise M. Stunes (Biological Sciences) DNA DAMAGE AS A MEASURE OF ENVIRONMENTAL STRESS IN ANIMALS
24	Collin E. Tanchanco Ocampo (Biological Sciences) AGE-DEPENDENT EFFECTS ON THE PERIPHERAL IMMUNE TRANSCRIPTOME FOLLOWING TRAUMATIC BRAIN INJURY
25	Mitchell V. Woodhouse (Biological Systems Engineering) AN INVESTIGATIVE COMPARISON OF CURRENT CLIMATE SERVICES
26	Joanna L. Osborne (Engineering Science & Mechanics) OPTIMUM SNAKE LOCOMOTION
27	Wenkun Liu (Mechanical Engineering) A NATURAL LOW-DENSITY STRUCTURE IN CUTTLEBONE: STRUCTURAL AND MECHANICAL ANALYSIS

Session 5 2:30-3:20PM

E1 **Caleb W. Thompson** (Mechanical Engineering)
EVENT DETECTION AND LOCALIZATION USING MACHINE LEARNING ON A STAIRCASE

1 **Agota N. Banks** (Biological Sciences)
INCENTIVES IN THE SERVICE INDUSTRY: IMPACT OF POSITIVE CONSEQUENCES USING EXTRINSIC MOTIVATORS ON BEHAVIOR

2 **Mackenzie Blankenship** (Biological Sciences)
DIFFERENTIATION OF PH IN ARABIDOPSIS MUTANTS

3 **Cole Bristow** (Meteorology)
IT'S NOT ROCKET SCIENCE

4 **Michelle M. Corinaldi** (Sociology)
THE RELATIONSHIP BETWEEN RACE AND CONFIDENCE IN THE COURT/LEGAL SYSTEM

5 **Harpreet Dhami** (Biochemistry)
MEASURING RADIOACTIVITY USING A GEIGER COUNTER

6 **Courtney R. Ebersohl** (History)
"SHE WOULD NOT GO ANYHOW": FREED WOMEN IN POST-CIVIL WAR FAIRFAX COUNTY (1865 -1872)

7 **David Ellwood** (Computational Modeling & Data Analytics)
ROCKET PROJECT

8 **Nathaniel C. Esteves** (Microbiology)
INVESTIGATION OF FACTORS INFLUENCING FLAGELLOTROPIC BACTERIOPHAGE LYSIS PATTERNS

9 **Alyssa E. Gentry** (Mechanical Engineering)
INVESTIGATION OF ULTRASOUND SHEAR WAVE ELASTOGRAPHY FOR TREATMENT FEEDBACK DURING FOCUSED ULTRASOUND ABLATION

10 **Rebecca K. Hawkins**
A TALE OF NATURAL HISTORY COLLECTIONS EDUCATION AT VIRGINIA TECH

11 **Renee N. Howard** (Environmental Planning & Policy)
EFFECTS OF EARTHGUARD PELLETS FROM THE MOUNTAIN VALLEY PIPELINE ON REGIONAL/AREA WATER QUALITY AND ORGANIC FARMS

12 **Emma A. Hultin** (Biology)
PHENOLOGY AND INTERACTIONS IN THE REPRODUCTION OF BLUEHEAD CHUB (NOCOMIS LEPTOCEPHALUS) AND CENTRAL STONEROLLER (CAMPOSTOMA ANOMALUM) AND THEIR NEST ASSOCIATES

Session 5 (continued)

13 Rachel J. Kelliher (Human Nutrition, Foods, & Exercise)
HOME: WHY PEOPLE PRACTICE AT A COMMUNITY-BASED YOGA STUDIO

14 Erin Le (Human Nutrition, Foods, & Exercise)
UNDERSTANDING THE MOLECULAR REGULATION OF NHLH2 IN PRADER-WILLI SYNDROME

15 Alexa M. Lynn (Animal & Poultry Science)
NUTRITIONAL INTERVENTIONS ALTER MUSCLE FIBER TYPE EXPRESSION IN NEONATAL PIGS

16 Patrick Manijayme (Landscape Architecture)
FLOAT LIKE A BUTTERFLY, THINK LIKE A BEE: AN OASIS FOR POLLINATORS AND PEOPLE

17 William W. Martin (Environmental Resource Management)
INVASIVE SPECIES INTRODUCTION AND THE EFFECTS ON NATIVE HOST-SYMBIONT RELATIONSHIPS

18 Christina A. Nelson (Wildlife Conservation)
INCORPORATING TECHNOLOGY AND MULTIDISCIPLINARY THINKING INTO UNIVERSITY COLLECTIONS

19 Kaitlyn R. Paulchell (Biological Systems Engineering)
EFFECT OF ROOT SURFACE STERILIZATION ON PLANT GROWTH

20 Daniel Riddle (Human Nutrition, Foods, & Exercise)
ANATOMICAL MODEL OF THE PANCREAS

21 Jacob Schaum (Clinical Neuroscience)
ROCKET PROJECT: CURIOSITY TO SHOOT FOR THE STARS

22 Cambrie M. Schumacher (Animal & Poultry Science)
EVALUATION OF THE EFFECT OF ESSENTIAL AMINO ACIDS ON MUSCLE AND MAMMARY GENE EXPRESSION

23 Shannon Sparks (Biology)
THE EFFECT OF WATER AVAILABILITY ON GROWTH OF MUTANT ARABIDOPSIS PLANTS

24 David C. Thames (Computer Science)
WORKFLOW FOR DEVELOPING VIRTUAL REALITY GESTURES USING MACHINE LEARNING

25 Olivia A. Wisnewski (History)
RECOVERING VETS OF WW1: RESEARCH IN THE ARCHIVES

26 Eleanore Woodruff (Biological Sciences)
DEVELOPING A PORTABLE SOLAR PANEL CHARGER AS A COMMON-INTEREST COMMUNITY TEAM

Session 5 (continued)

27 Madison Gonzalez (Animal & Poultry Science)
CITRULLINE SUPPLEMENTATION AS A MEANS TO IMPROVE POST-EXERCISE MUSCLE RECOVERY IN HORSES

Session 6 4:00-4:50PM

E1 **Anna S. Charlton** (Psychology)
THE ROLE OF EMOTION REGULATION ON COMORBID PSYCHOPATHOLOGY IN TRANSITION-AGE INDIVIDUALS WITH ASD

E2 **Courtney R. Ebersohl** (History)
ENACTING FREEDOM: BLACK VIRGINIANS IN THE AGE OF EMANCIPATION

E3 **Ksenia Pereverzeva** (Biological Sciences)
COMPARING PLANT USES AMONG COASTAL PLAIN CULTURES IN COLONIAL VIRGINIA

1 **Grace K. Carey** (Environmental Horticulture)
IDENTIFICATION OF ARBUSCULAR MYCORRHIZAL FUNGI SPECIES IN SOYBEAN ROOTS

2 **Esther S. Cho** (Literature & Language)
PITCH AND POLITENESS IN KOREAN

3 **Nicholas A. Cramer** (Biochemistry)
CHEMICAL FEATURES OF BORRELIA BURGDORFERI PEPTIDOGLYCAN AND THEIR IMPLICATIONS IN THE PATHOGENESIS OF LYME DISEASE

4 **Olivia Evans** (Microbiology)
MODEL OF A RUMINANT STOMACH

5 **Morgan Gallagher** (Environmental Sciences)
TOWARDS AN UNDERSTANDING OF DISSOLVED METHANE DYNAMICS IN OXIC STREAMS

6 **Sydney S. Kulok** (Psychology)
AN ANALYSIS OF SOCIAL COMPETENCE IN INDIVIDUALS WITH AUTISM SPECTRUM DISORDER AND CO-OCCURRING CONDUCT PROBLEMS

7 **Eric D. Luu** (Multimedia Journalism)
AUDIENCE RESPONSES TO ASIAN-AMERICAN HATE SPEECH IN IMMERSIVE VIDEO

8 **Sid S. Madhavan** (Clinical Neuroscience)
IDENTIFICATION OF KEY SEQUENCES IN HUMAN TAU PROTEIN FOR AGGREGATION IN DEMENTIA

9 **Jared A. Okada** (Systems Biology)
A COMPUTATIONAL APPROACH TO CHARACTERIZING THE INTERACTIONS BETWEEN RCAN1.4 AND RAF1, TWO PROTEINS INVOLVED IN DOWN SYNDROME TUMOR REGULATION

10 **Daniel J. Purcell** (Biomedical Sciences)
THE ROLE OF CONNEXIN 43 DURING EPITHELIAL TO MESENCHYMAL TRANSITION

Session 6 (continued)

11 **Fernando Ramos-Diaz** (Physics)
GEIGER COUNTER STUDIO PROJECT

12 **Molly S. Sayles** (Civil Engineering)
INTERDISCIPLINARY SOLUTIONS FOR THE PROBLEM OF FACILITATING COMMUNICATION IN A REAL TIME WATER AND WEATHER MONITORING SYSTEM

13 **Marilyn J. Steinbach** (Biology)
A NEUROPHYSIOLOGICAL INVESTIGATION OF BOREDOM

14 **Lydia Stonerook** (Human Nutrition, Foods, & Exercise)
ANATOMICAL MODEL OF THE HUMAN UTERUS

15 **Erica S. Townsend** (Cognitive & Behvioral Neuroscience)
ADAPTIVE FUNCTIONING AND DEPRESSIVE SYMPTOMS IN MINIMALLY VERBAL CHILDREN WITH ASD

16 **Becky Y. Tran** (Animal & Poultry Sciences)
EFFECTS OF BUTYRATE ON NITROGEN CORRECTED APPARENT METABOLIZABLE ENERGY OF BROILER CHICKS

17 **Robert S. Tulloss** (Aerospace Engineering)
COMPUTATIONAL EFFORT REDUCTION FOR DISCONTINUOUS BEAM ANALYSIS USING MIXED-DIMENSIONAL MODELLING

18 **Morgen VanderGlessen** (Biochemistry)
BIOLOGICAL CLOCKS AND OXIDATIVE STRESS IN AEDES AEGYPTI MOSQUITOES

19 **Courtney Walls** (Crop and Soil Science, Genetics and Breeding)
VALIDATION OF QUANTITATIVE TRAIT LOCI (QTL) UNDERLYING KUNITZ TRYPSIN INHIBITOR IN SOYBEAN SEEDS

20 **Yueying Wang** (Biochemistry)
ELUCIDATING THE ROLE OF MEMBRANE-BOUND AND SECRETED PROTEINS IN FUSOBACTERIUM NUCLEATUM VIRULENCE

21 **Taylor A. Warburton** (Geosciences)
SPATIAL MAPPING OF TRACE ELEMENT CONCENTRATIONS IN WELL WATER IN VIRGINIA

22 **Eva Whaley** (Mathematics)
CREATING A DATA-COLLECTING ROCKET THROUGH COLLABORATIVE LEARNING.

21 **Jacob E. Riney** (Computer Science)
RECONSTRUCTING CLIMATE CHANGE RESPONSES OF THE FERN GENUS CRYPTOGRAMMA FROM THE LAST GLACIAL MAXIMUM AND ONWARDS

Session 6 (continued)

23 Kimberly C. Winck (Animal & Poultry Sciences)
EVALUATING NLRX1 PROTECTION DURING TOXOPLASMA GONDII (T. GONDII) INFECTION

24 Allison Woods (Computational Modeling & Data Analytics)
THE DEVELOPMENT OF PROJECT OZONE: A ROCKET

25 Abigail W. Workmeister (Biochemistry)
NUTRITIONAL IRON AS A SOLE VARIABLE FOR CIRCADIAN CLOCK RESETTING IN LIVER CELLS

26 Joanne Tang (Mechanical Engineering)
ECHO DATA CLUSTERING

27 Melody Caloyannides (Mechanical Engineering)
MICRO-STRUCTURE DESIGN FOR IMPLANT MATERIALS

Abstracts

AMBER R. N. ABBOTT
VIRGINIA TECH / MICROBIOLOGY

Ret signaling in herpes simplex virus latency and reactivation

Neurotrophic factors (NTFs) contribute to the maintenance of herpes simplex virus (HSV) latency in neurons. We previously determined that deprivation of two NTFs called glial cell-derived neurotrophic factor (GDNF) and neurturin (NTN) induces reactivation of HSV from latency in adult sensory neurons. GDNF and NTN, upon binding to GDNF family receptors (GFRs), activate Ret, a receptor tyrosine kinase that regulates numerous intracellular signaling pathways involved with cell proliferation and differentiation. One of these pathways is the phosphoinositide 3-kinase (PI3K)/AKT pathway, which is initiated by Ret autophosphorylation at the site Tyr1062 and has been implicated in maintaining HSV1 latency in embryonic sympathetic neurons. Therefore, we aimed to establish the link between Ret Tyr1062-associated NTF signaling and HSV latency in primary adult sensory neurons. To do so, we investigated the effects of three novel compounds (BT13, BT18, and BT44) that have recently been found to activate Ret in the absence of GDNF and NTN, and determined that BT18 can prevent reactivation during NTF deprivation. However, results from western blots show that Ret is not phosphorylated at Tyr1062, even in uninfected cells. Additionally, four other sites remain unphosphorylated as well. Together, these findings show that NTF signaling through Ret contributes to maintaining HSV latency in adult sensory neurons, but not necessarily through the PI3K/AKT pathway.

Mentor: Dr. Andrea Bertke (Population Health Sciences, Virginia-Maryland College of Veterinary Medicine)

ALVIN AUNG
VIRGINIA TECH / MECHANICAL ENGINEERING

Investigation of Phase Separation of Motile and Non-motile Populations in Microbial Communities

In nature, many species of bacteria with dissimilar physical and behavioral characteristics coexist in complex communities. Studying the physical interactions of motile and non-motile subpopulations could elucidate the mechanisms that underpin emergent spatial organization and transport. In this study, we utilized motile, uropathogenic Escherichia coli and non-motile mutants to investigate the steady-state spatial organization of the two populations in a microfluidic device. This platform provided a controllable environment in which we induced chemotaxis (i.e., biased migration due to a chemical gradient) of the motile strain. We observed separation of the motile and non-motile phases to occur on the order of minutes. Keeping the total number of cells constant, we combined various ratios of non-motile to motile bacteria and defined quantitative metrics to describe the emergent community structure. We found that the distribution of motile bacteria varied little with ratio, while the non-motile bacteria covered a larger fraction of the microfluidic channel with increasing concentration. In contrast, the separation distance between the densest regions of bacteria was similar regardless of ratio. Future study of microbes of different sizes will further reveal how physical traits affect outcome. This research has implications for understanding physical interactions in microbial community self-organization, including in pathological conditions such as urinary tract infections.

Mentor: Bahareh Behkam (Mechanical Engineering, Virginia Tech)

OSSAM A. AWAN
VIRGINIA TECH / BIOLOGY

Image Analysis and Quantification of Bacterial Filament Motility in Clostridium perfringens

The purpose of this study is to examine Clostridium perfringens, which are Gram-positive anaerobic bacterium that commonly cause numerous diseases in humans and animals, including intestinal tissue infection. The goals of this study include using video analysis to determine characteristics of the cell chain including growth patterns such as when the cell chains start to curve and stability, which includes when the cell chain tends to break apart. Additionally, use bacterial tracking software to gain statistics from tracking the cell, which will give insight into the behavior of the cells and inform the mathematical model. After examination of the cell chain characteristics, it was determined that cell chains that contain multiple filamnts that grow side by side tend to start curing. The more filaments that are present, the more stable the cell chains become, resulting in less breakage and larger growth rate. Lastly, single or fewer cell chains tend to grow more straight but break apart more easily. Therefore, we hypothesize that C. perfringens relies on continuous growth of long bacterial chains that form from persistent cell-cell linkage after cell division.

Mentors: Jing Chen (Biology, Virginia Tech), Sean McMahon (Physics, Virginia Tech)

AGOTA N. BANKS
VIRGINIA TECH / BIOLOGICAL SCIENCES
JORDAN OLIVER
VIRGINIA TECH / BIOLOGICAL SCIENCES AND PSYCHOLOGY
EMMA HERDEGEN
VIRGINIA TECH / PSYCHOLOGY

Incentives in the Service Industry: Impact of Positive Consequences Using Extrinsic Motivators on Behavior

The behavioral impact of an extrinsic incentive/reward gratuity was evaluated systematically at various restaurants in a college town in southwest Virginia. Diners ate at a local restaurant under two conditions: Baseline (normal dining conditions) measuring intrinsic motivation, and Incentive (a 6" x 9" sign was placed on the table with the message, "Your Tip So Far.") measuring extrinsic motivation. One quarter was placed at the base of the sign, and quarters were added intermittently following positive server behavior and removed following negative server behavior. When asked about the sign, a diner replied, "Our gratuity with your service will be based on behavior; whenever we are pleased with your service behavior, we will add a quarter to the pile. If we are displeased, we will remove a quarter." In both conditions, the diners used the same behavioral checklist to independently record designated service-related behavior, including the frequency of table visits to provide service and/or initiate polite conversation. Diners are encouraged to only remove quarters if necessary. At the end of the meal, the overall quality of the service based on the total tip accumulated; and for the incentive condition, the server who delivered the final bill to the table was asked, "How did the sign impact your performance?" Each diner recorded the response to this question on the checklist. 20 checklists per the two conditions will be completed and analyzed before the April conference.

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

MELISSA BARNES
VIRGINIA TECH / ANIMAL AND POULTRY SCIENCES

Preventing iron deficiency anemia in pigs fed antibiotic-free diets containing high copper levels

The purpose of this study was to determine if changing the time of iron injection helped to decrease the number of anemic pigs at the age of weaning. Once the pigs were weaned, we then added copper to their diets to see if it aided in weight gain. These variables were chosen due to the current restrictions on antibiotics used in commercial pig production. The experiment involved splitting the pigs into 3 treatment groups for the iron injections and 2 testing groups for the copper trials. For the iron injections, group 1 got 200 mg of iron at birth, group 2 got 100 mg at birth and 100 at weaning (day 21), and group 3 got 100 mg at birth and 100 mg at 14 days of age. Once they were weaned, the 3 treatment groups got separated into 2 testing groups, ones that were fed normal feed and one that were given a copper supplement. The desired results were for group 3 to have the lowest anemia rate and the copper fed pigs to have the highest weight gain. There were signs of some increased weight gain, but not enough to be notable at the given point of the experiment.

Mentor: Dr. Mark Estienne (Tidewater Agricultural Research & Extension Center, Virginia Tech)

EROD KEATON D. BAYBAY
VIRGINIA TECH / PHYSICS

Unpacking the z-stack: volumetric whole-cell and nuclear fits for image analysis of localized fluorophores in fission yeast

Fission yeast is an excellent model organism for understanding the underlying pathways essential to cell division. Contemporary methods for analyzing these pathways often employ the visualization of proteins tagged with fluorescent markers. In order to observe the localization and concentration of fluorophore-tagged proteins in a large population of cells, automated microscopy and image analysis tools have been developed over the past decade with a variety of approaches to cell detection, segmentation, and data collection. We have developed an image analysis pipeline that uses a combination of bright-field images, fluorescent markers, and the known morphological characteristics of fission yeast to produce a volumetric fit of a cell's whole-cell and nuclear geometry. Using a volumetric fit allows for an image analysis that captures the entire cell, which is necessary for quantifying localized signals that may not be apparent when viewed from a single focal plane.

Mentor: Silke Hauf (Biological Sciences, Virginia Tech)

LAURA C. BEAUDET
VIRGINIA TECH / PSYCHOLOGY

Williams Syndrome Sibling Survey

Although individuals with Williams syndrome (WS) are known to be at heightened risk for anxiety disorders and social victimization, families of these individuals frequently report positive effects of having a child with WS. However, few studies have been conducted examining outcomes for siblings of this population. We used an online survey to collect data from 20 siblings of individuals with Williams syndrome on stress, the sibling relationship, and behavior problems. These data were compared to existing results from siblings of individuals with autism spectrum disorder and Down syndrome. Siblings reported that parents showed preferential treatment to the child with WS, but did not report any significant unbalance in the sibling relationship. Neither behavior problems among the individual with WS nor the sibling relationship correlated with sibling self-reported stress. Additionally, WS-Sibs reported significantly less overall stress than siblings of individuals with autism, even when controlling for sibling age and brother/sister behavior problems ($B = -1.68$, $p < .001$). These results can help families and service providers better service families with WS and other intellectual disabilities by identifying factors that are important to siblings. Additionally, further studying the low levels among WS-Sibs can help researchers identify protective factors that can then be used to support families of individuals with other types of disability.

Mentor: Carolyn Shivers (Human Development, Virginia Tech)

MACKENZIE BLANKENSHIP
VIRGINIA TECH / BIOLOGICAL SCIENCES
JOSHUA HAUELS
VIRGINIA TECH / SYSTEMS BIOLOGY
KATHLEEN MARSCALKO
VIRGINIA TECH / CLINICAL NEUROSCIENCE
BRITTNEY SOLOMON
VIRGINIA TECH / MICROBIOLOGY
NICHOLAS RUSSELL
VIRGINIA TECH / COGNITIVE AND BEHAVIORAL NEUROSCIENCE

Differentiation of pH in Arabidopsis mutants

As students in the Curie and Da Vinci Living Learning Community, we took part in a collaborative project this spring semester. Our project goal was to better understand the function of a mutant gene in Arabidopsis plants. We are testing pH and its effects on the plants by adding baking soda into the water for our experimental groups. Soil pH is crucial to the success of plants and wild type Arabidopsis have been known to survive in a wide variety of soil pH. By changing the pH of the soil with the introduction of baking soda, we documented the survival rates of Arabidopsis mutants and wild types in a basic environment. Baking soda dissociates in water and allows for hydroxide ions to be released into the solution, increasing the pH. Experimental groups were subjected to a dilute baking soda solution to elevate pH, while control groups received normal amounts of water without baking soda. We hypothesized that the genetically altered plants would not respond as well to pH changes. If the mutated gene coded for a protein that is involved in survival in varied levels of acidity, there may be a difference in the response of the wildtype and control groups. If there is a difference, the gene can be determined to affect pH survivability and from there, more studies can be done to determine the gene's exact function. We will present our results and learning experiences with the project.

Mentor: Lori Blanc (Biological Sciences, Curie & Da Vinci LLC, Virginia Tech)

ABIGAIL M. BOCK
VIRGINIA TECH / GENERAL ENGINEERING

Development of 3D-sacrificial environments to study tumor growth and invasion

Upwards of 90% of cancer-related deaths is caused by metastasis. While the genetic and biochemical components of metastasis have been investigated for the last 50 years, little research has been done into how the physical microenvironment influences the development of a malignant tumor. Two-D well-plates, the traditional means of observing cancer, are limited in measuring complex 3D interactions, mechanical properties, structural changes, and abnormal morphology which contribute to the proliferation and spread of tumor cells. The use of 2D well-plates does not operate as a reliable platform to adequately determine the effectors that lead to the invasive processes that characterize the metastatic stage. We propose to develop a 3D-sacrificial bioprinting system to generate biodegradable scaffolds of filament networks to grow multicellular acini in a defined architectural matrix and keep them viable for long periods. We aim to use this technology to uncover how factors at the molecular level are impacted by phenotypic changes resulting from higher-order cell processes that are inherently 3D; hence, providing a more realistic assessment of the impact of the microenvironment when adhesive, mechanical, and chemical components are taken into consideration. As a result, we aim to use our 3D system to test whether the translation of mechanical forces and deformations into biochemical signals that originate in the microenvironment contribute to the fate of a cancer cell.

Mentor: Carla Finkielstein (Biological Sciences, Virginia Tech)

ETHAN D. BOEDING
VIRGINIA TECH / NANOSCIENCE
BEN CLARK
VIRGINIA TECH / WATER: RESOURCES, POLICY & MANAGEMENT

Quantifying nucleic acid association to nanoparticles

The goal of this project is to investigate if nanoplastics and gold nanoparticles (AuNPs) will sorb nucleic acid such as DNA. Nanoplastic wastes potentially originate from consumer products that are common to households, such as face washes, body washes, and cosmetic products. These nanoscale plastic particles potentially interact with their surrounding environment as they are discharged to wastewater treatment facilities and ultimately to water bodies. In wastewater treatment facilities, there is potential for the creation of recombinant genetic material to propagate antimicrobial resistance (AMR). We hypothesize that nanoplastic wastes could alter AMR propagation by sorbing and later releasing AMR promoting genetic materials. In this study, AuNPs of various sizes and charges ranging from 4-13 nm in diameter were used as a model nanomaterial and were synthesized in-house and polystyrene nanoparticles were purchased to represent nanoplastics. DNA samples were exposed to these nanoparticles, incubated for a fixed period of time, and then the nanoparticles were removed via centrifugation and the DNA that remained in the supernatant was quantified using a Qubit Fluorometer or Synergy HTX Plate Reader. New, promising results show that the positively charged nanoparticles sorbed some percentage of DNA onto the surface of the nanoparticles, demonstrating that transport for AMR is possible.

Mentors: Peter Vikesland and Matt Chan (Civil and Environmental Engineering, Virginia Tech)

COLE BRISTOW
VIRGINIA TECH / METEOROLOGY
CALEB BROWN
VIRGINIA TECH / METEOROLOGY
ELIZABETH DANCO
VIRGINIA TECH / METEOROLOGY
CHRISTINA TRAN
VIRGINIA TECH / PHYSICS
ZACHARY WOJCIK
VIRGINIA TECH / PHYSICS

It's Not Rocket Science

The goal of this work is to create a model rocket with the highest possible levels of altitude and velocity. The process of making this rocket includes creating a model of the rocket in the software OpenRocket, attending trainings on how to work with various aspects of the build, assembling the rocket based on the model, and then launching the rocket and recording the data from the launch. The primary purpose of this project is to create a rocket as a team by combining our individual strengths and working as a cohesive unit throughout its design, execution, and presentation. The intention of the project is to build experience in teamwork for the members, while simultaneously learning about concepts in physics through a hands-on build process. Our team completed training in soldering, laser cutting, and Arduino and Matlab coding. We designed and completed our model rocket using OpenRocket, software which allows for users to design and simulate flight for model rockets by adjusting elements such as fin design. Projected outcomes include an operational rocket model that performs according to virtual simulations on Open Rocket and project specifications, and to develop collaborative teamwork, and hands-on skills that will be relevant to future careers in science.

Mentor: Lori Blanc (Biological Sciences, Curie and Da Vinci LLC, Virginia Tech)

SYDNEY BUCK
VIRGINIA TECH / CONSTRUCTION ENGINEERING & MANAGEMENT

The Impact of International Service-Learning Projects on Students' Engineering Education

The purpose of my research is to evaluate engineering students experience taking an international service-learning course. The research focuses on the impact the trip had on students' classroom knowledge. Specifically, I looked at the challenges the students faced designing a latrine across the world and how those challenges transcended on site. Each student who participated realized that needs and wants are very different globally and so human-centered designs are vital to the success of a project in a third-world nation. Overall, students gained first hand engineering experience and acquired global citizenship through their work building latrines.

Mentors: Dr. Freddy Paige (Civil & Environmental Engineering, Virginia Tech), Brooke Baugher (Civil & Environmental Engineering doctoral candidate, Virginia Tech)

MELODY CALOYANNIDES
VIRGINIA TECH / MECHANICAL ENGINEERING

Micro-structure Design for Implant Materials

The objective of the proposed research work is to design beta phase Titanium alloy microstructures which are widely used as implant structures. Since the implant materials are used in human bodies, they have to obey certain restrictions. For example, the implant structure should provide the same Youngs modulus value with Young,Äôs modulus of a human bone (around 20-30 GPa). For this purpose, the microstructure will be optimized to achieve a comparable averaged Young's modulus value with that of the human bone. We use a computational model that predicts Young's modulus of the Titanium alloy microstructure as a function of the volume fractions of different grains. We perform an optimization study to find the optimum volume fraction values that minimize the difference between Young's modulus of the alloy and human bones.

Mentor: Pinar Acar (Mechanical Engineering, Virginia Tech)

KEDI CAO
VIRGINIA TECH / SYSTEMS BIOLOGY

Mathematical modeling of PER2-p53-MDM2 network dynamics

The tumor suppressor protein p53 is under the control of the circadian factor period 2 (PER2) and its negative regulator MDM2. Cell cycle progression and DNA-damage-response pathways are under circadian control. When DNA-damage happens, circadian rhythm will respond to the damage which lead to a phase resetting. Such resetting of circadian clock phase is commonly presenting as advance. Phase advance is a shift of circadian rhythm to earlier than normal. This phenotype is increasingly associated with the existence of cross-talk mechanisms between clock proteins and checkpoint components. However, we are still lacking knowledge on the molecular mechanism responsible for phase advance in response to any form of genotoxic stress. A mathematical model was built to predict the underlying interactions between PER2 and p53, simulate conditions to generate whole phase response curves. The model itself is consisted with different protein related transcriptions, translations, ubiquitinations and cellular localizations. The model will take advantage of existing experimental data and generate results to support the ongoing of future experiments. A multi-scale modeling strategy has been useful for our work on the mammalian clock. So far, a set of mathematical equations has been developed based on the current wiring diagram. DNA-damage will be added into the model for future investigation to reveal the minimum molecular criteria that induce circadian phase advance.

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

KAYLA B. CAREY
VIRGINIA TECH / APSC

Understanding the impact of Ascorbic Acid on in vitro-derived porcine embryos during preimplantation development

The objective of this study is to evaluate the effect of Ascorbic Acid (AA) on the development of porcine in vitro fertilized (IVF) embryos. Conventional embryo culture systems do not consider the nutrients required to properly maintain epigenetic marks of viable embryos despite changes in epigenetics during embryogenesis. Key epigenetic marks in early embryos are controlled by the TET family enzymes that require co-factors such as AA. To conduct this experiment, oocytes were collected and IVF was completed. Presumed zygotes were treated with either a control media or a media containing 50 ug/ml of AA. Day 7 blastocysts were collected and analyzed using quantitative real-time PCR and immunocytochemistry. Student's t-test was used to compare the differences in blastocysts. From the PCR analysis, it was discovered that 3 pluripotency-related genes (NANOG, SOX2, and ESRRB) were significantly downregulated ($p<0.05$) and TET1 had a tendency to be downregulated. Average blastocyst formation showed no significant difference between groups (control 21.49% Â±3.81; AA 20.3% Â±3.38). Cell number in the blastocysts showed no significant difference between groups (control average 58.05% Â±2.78; AA 57.67% Â±4.03). The level of 5mc was significantly lower in AA treated embryos ($p<0.05$) whereas there was no difference in the level of 5hmc. Our results indicate that AA does have an impact on the expression of pluripotency genes, but further studies are needed to verify specific roles.

Mentor: Kiho Lee (APSC, Virginia Tech)

GRACE K. CAREY
VIRGINIA TECH / ENVIRONMENTAL HORTICULTURE

Identification of Arbuscular Mycorrhizal Fungi Species in Soybean Roots

Arbuscular Mycorrhizal fungi (AMF) are mutualists inhabiting the roots of over 90 percent of plant species. AMF are known to convert phosphorus and other nutrients into forms which the host plant can use while acting as an extension of the plant root by increasing surface area and thereby accessing otherwise inaccessible water and nutrients. AMF are of high interest in sustainable agriculture due to their potential to greatly reduce fertilizer applications to crop fields while increasing plant health, biomass, and drought tolerance. Although AMF's status as an important contributor to crop health is well recognized, the comparative benefit of individual AMF species is less understood. This study aims to identify whether certain AMF species preferentially associate with certain soybean cultivars, with the goal of eventually identifying the individual AMF species which are most associated with the greatest crop yields. Direct observation of AMF morphology alone does not allow for accurate species identification. This study instead focused on DNA extraction, PCR, and Sanger sequencing. DNA was extracted from collected soybean roots using the CTAB method, then amplified with PCR using an AMF-specific primer pair and processed with Sanger sequencing. Results will identify and describe the presence or absence of association trends between AMF species and the soybean cultivars surveyed.

Mentor: Mark Williams (School of Plant and Environmental Sciences, Virginia Tech)

CARL CHALK
VIRGINIA TECH / PHYSICS
NATHAN STROH
VIRGINIA TECH / PHYSICS
MARCO BRIZZOLARA
VIRGINIA TECH / PHYSICS
JACK MCLAUGHLAN
VIRGINIA TECH / PHYSICS

Rocket Construction Project

Students in the Curie and Da Vinci Science Living Learning Community collaborate on semester-long projects that prepare students for the practice of science through the development of teamwork, critical thinking, and problem solving skills. Using a residential Makerspace, this project focused on designing and building a rocket that can fly to an altitude of 750 feet and collect relevant flight data. The secondary goal of this project is to use the flight data gathered by the rocket (e.g., orientation, acceleration, etc.) to accurately describe the rocket's flight path, evaluate the effectiveness of its design, and evaluate areas of improvement. The rocket project consisted of three phases: training, design, and construction. During the training phase, we learned how to code and studied conceptual foundations necessary for rocket construction. During the design phase, we developed the rocket design and its payload components in OpenRocket, then simulated its chance of success. In the construction phase, we built and launched the rocket. We completed the rocket design and construction prior to launch in April. We will present launch data collected from the onboard electronics bay, and discuss the effectiveness of our rocket and skills learned throughout the project.

Mentor: Lori Blanc (Biological Sciences, Curie and Da Vinci LLC, Virginia Tech)

ANNA S. CHARLTON
VIRGINIA TECH / PSYCHOLOGY

The Role of Emotion Regulation on Comorbid Psychopathology in Transition-Age Individuals with ASD

Deficits in emotion regulation (ER) are commonly observed in individuals with ASD and may contribute to elevated rates of comorbidity. Deficient ER may lead to, or exacerbate, symptoms of co-occurring anxiety and depression. Self-reported involuntary ER strategies (e.g., rumination) have shown to be related to self- and caregiver-reported psychopathology. However, a gap in the literature remains regarding variations in ER among individuals with ASD and comorbid diagnoses. This study sought to understand the relationship between self- and caregiver-reported ER (as indexed by RSQ) and clinician-assigned diagnoses (ADIS-P/C) by analyzing a sample of 27 transition-aged individuals with ASD (74% male, mean age 18.54 years). Participants with an anxiety or depressive disorder demonstrated significantly greater involuntary engagement than those without diagnoses of anxiety ($t(21) = -3.11$, $p = .005$) or depression ($t(21) = -2.87$, $p = .009$). Furthermore, those without an anxiety disorder ($t(21) = 2.11$, $p = .047$) or depressive disorder ($t(21) = 2.58$, $p = .017$) reported significantly more voluntary engagement. Yet, the same significant relationship was not established between caregiver-reported ER and diagnoses. We also evaluated associations between ER and continuous measures of internalizing and externalizing problems using ASEBA measures (CBCL/ABCL). Caregiver-reported involuntary engagement was significantly correlated with caregiver-reported internalizing symptomology.

Mentor: Susan White (Psychology, University of Alabama)

MICHAEL W. CHEN
BLACKSBURG HIGH SCHOOL /HIGH SCHOOL STUDENT

The Role of EphA4 in Vascular Gene Inflammation

EphA4 is essential in the development and recovery of the cerebrum during trauma. EphA4 is a member of the EphA4 subclass of Eph receptors and can bind to both Ephrins A and Ephrins B. Previous studies have shown that EphA4 is key in the development of neuronal connectivity as well as synaptic plasticity, vascular formation, axon regeneration and repair of the central nervous system. Increased EphA4 and pro-inflammatory gene expression is correlated with increased brain injury severity in patients. Studies show that EphA4 is expressed heavily in areas of inflammation within the cortex, however it remains unclear its role in mediation in inflammation. Previously it was shown that suppression of EphA4 after injury to the brain resulted in reduction of damage and attenuation of the inflammation. To test the role of EphA4 in inflammation, VTM-EEK (VTM) and KYL were utilized to inhibit EphA4 gene expression and lipopolysaccharide (LPS) was used to simulate an inflammatory environment. 300,000 endothelial cells were plated into a gelatin coated 6-well plate and four treatment groups were created: LPS-, LPS+, VTM+ LPS+, KYL+ LPS+. Quantitative real-time polymerase chain reaction (qPCR) was conducted and data was gathered using GraphPad Prism, version 7 (GraphPad Software, Inc., San Diego, CA). Our data demonstrate brain-derived endothelial cells show reduced pro-inflammatory mRNA expression following EphA4 suppression via VTM peptide inhibition or genetic knockdown.

Mentor: Michelle Theus (Biomedical Science, Virginia Tech)

ESTHER S. CHO
VIRGINIA TECH / LITERATURE & LANGUAGE

Pitch and Politeness in Korean

The frequency code (Ohala 1984) describes the universal association between pitch and size, and resultingly between high pitch and politeness. However, production studies on Korean have found the opposite pattern: speakers lower their pitch on polite forms (Winter & Grawunder 2012; Brown et al. 2014). In this matched guise study, we investigate whether these findings reflect insensitivity to the frequency code, different conceptualizations of politeness, and/or how politeness is being measured. We recorded 8 native Korean speakers in Seoul reading sentences at three grammatical levels of politeness, and their f0 was manipulated to create three different pitch guises. 30 listeners in Seoul will rate the speakers on social attributes that target aspects of the frequency code (e.g., size), and possible dimensions of (im)politeness (e.g., deference). We are interested in how these ratings change as a function of grammatical, pitch, and interactions between the two.

Mentor: Abby Walker (English, Virginia Tech)

COLLEEN P. CHRISMAN
VIRGINIA TECH / MATHEMATICS

Gender Inequity in High Stakes Cinematic Achievement Awards

This study analyzes the outcomes of five prestigious acting awards across the globe to understand the magnitude of gender discrimination and the progression towards gender equality over time. We collected data on the winners and nominees in the Best Actor and Best Actress categories for the Academy Award (USA), the BAFTA Award (UK), the CÃ©sar Award (France), the Filmfare Award (India), and the Goya Award (Spain). This study seeks to uncover whether there is any truth to the popular notion that gender discrimination manifests itself as age discrimination in the entertainment industry, especially in lead acting awards. After finding and recording the ages of the nominees, the age differences between males and females are used in a variety of ways to understand the effect of gender discrimination on the outcomes of these awards. The derived age differences for the winners and nominees are compared within each country as well as over time. Cross-country comparisons take into account each country's ranking on the Gender Inequality Index and help us understand the role of culture. Our analysis reveals a distinct preference for youth in women on an international scale, though there exist interesting temporal and cultural patterns as well.

Mentors: Sudipta Surangi and Aris Spanos (Economics, Virginia Tech)

EMILY R. CLIFFORD
VIRGINIA TECH / COGNITIVE NEUROSCIENCE

Parent Stress and Childhood Aggression in Children with Autism Spectrum Disorder

Parents of children with Autism Spectrum Disorder (ASD) have higher stress rates than nearly any other parenting population. Children with ASD also show higher rates of aggression compared to their typically developing peers. Previous studies have shown that parents who report more stress also report more externalizing behaviors in their young children than parents with less stress. Objective:Examine the question that, consistent with previous literature, will parents of young children with ASD and higher parental stress report higher levels of child aggression? Hypothesis: It is hypothesized that in parent of children with ASD, higher parental stress will be correlated with higher child aggression. Method: 13 children (1 girl and 12 boys) with ASD between the ages of 2 and 6 and their parents were brought in for a Pivotal Response Treatment (PRT) study. Initial intake measures included Autism Parenting Stress Index (APSI) and the Child Behavior Checklist Aggression Subscale. These measures were collected at an intake session for part of a larger study. This session was 2 hours long and included both parent report and clinician administered child measures. Results: A correlation was conducted between the T-score of the CBCL aggression subscale and the APSI total score. Results showed a significant relationship between parent stress and aggression. (r=.719; p=.006). Children with Autism are more likely to show aggressive behavior if parents report higher stress.

Mentor: Angela Scarpa (Psychology, Virginia Tech)

GABRIEL M. COLEMAN
VIRGINIA TECH / NEUROSCIENCE

EphA4 is novel mediator of neuroinflammation and tissue loss following traumatic brain injury

Traumatic Brain Injuries (TBIs) are a major cause of death and disability in the US accounting for 30% of all injury deaths. When the blood brain barrier (BBB) is penetrated, peripheral monocytes infiltrate the affected area and cause increased inflammation and dead tissue. In TBIs, EphA4 blocks phosphorylated Akt which is a kinase that causes macrophages to switch from M1 (pro-inflammatory) to M2 (anti-inflammatory). When EphA4 is expressed, macrophages retain their M1 polarization and contribute to increased inflammation in the TBI milieu. By using an EphA4 inhibitor, KYL, and a covalently bonded nanoparticle to help diffuse through the injury, EphA4 can be repressed. By finding a way to therapeutically reduce lesion volume after TBI, patients can maintain a better quality of life. Experimentally, mice are subjected to a Controlled Cortical Impact (CCI) and then given either a saline control or the nanoparticle with KYL. After euthanization and removal of the brain, a cryostat is used to take sections of the brain around the injury/hippocampal area. Stereoinvestigator software is then used to calculate lesion volumes and compare the two groups of mice. The mice that were given the neuroprotective KYL present a smaller volume of affected tissue than those who were given the saline control.

Mentor: Dr. Michelle Theus (Biomedical Sciences & Pathobiology, Virginia-Maryland College of Veterinary Medicine)

MICHELLE M. CORINALDI
VIRGINIA TECH / SOCIOLOGY
GRACE U. KIM
VIRGINIA TECH / CRIMINOLOGY
FRANCISCA Y. PEREZ
VIRGINIA TECH / CRIMINOLOGY
KEYANA M. REDMON
VIRGINIA TECH / CRIMINOLOGY

The Relationship between Race and Confidence in the Court/Legal System

Individuals' confidence in the court/legal system significantly influences their contact with the legal system, including interactions with police officers, lawyers, and other agents in law enforcement. Understanding confidence in the court/legal system and factors that influence the confidence is crucial to promote increased trust in law enforcement. The purpose of this research is to investigate the relationship between race and confidence in the court/legal system. Using data from the General Social Survey (GSS) collected in 2008, we performed bivariate and multivariate analyses to examine how an individual's race influences their confidence in the court/legal system. The results showed that Blacks with a high school education were more likely to have confidence in the court/legal system, while Whites with a post-secondary education were more likely to have confidence in the court/legal system. We hope that this sociological research can contribute to the broader discussions about the relationship between citizens and law enforcement, what factors affect the mutual trustworthiness (or untrustworthiness), and ultimately how they can be improved in the future.

Mentor: Haiyan Zhu (Sociology, Virginia Tech)

NICHLAS A. CRAMER
VIRGINIA TECH / BIOCHEMISTRY
MEGAN FOUCH
BIOCHEMISTRY

Chemical features of Borrelia burgdorferi peptidoglycan and their implications in the pathogenesis of Lyme disease

Borrelia burgdorferi is the causative agent of Lyme disease, a disease that affects more than 300,000 new people each year in the United States. While mechanisms behind B. burgdorferi pathogenesis remain mostly unknown, recent research efforts strongly indicate that B. burgdorferi peptidoglycan (PG), an essential component of the bacterial cell wall, is a key feature. Peptidoglycan fragments, released by B. burgdorferi during growth, have been recovered from patients suffering from Lyme arthritis long after antibiotic treatment has ceased. It is thought that B. burgdorferi PG may be structurally unique from other bacterial PGs, and that these structures have longer half-lives in the human body leading to inflammatory responses. The goal of our studies is to characterize the structural features of B. burgdorferi PG, the components released, and their fate in human tissues. In most bacteria, PG is held in place by proteins covalently linked into the cell envelope. B. burgdorferi lacks any recognizable homologues of these highly conserved proteins. We contend that released PG may also contain unique protein(s), which contribute to Lyme pathogenesis and/or host response. Using a novel approach that exploits human PG receptors, coupled with LC-MS, our studies promise to uncover the muropeptides and/or proteins involved in B. burgdorferi pathogenesis.

Mentors: Brandon L. Jutras and Richard F. Helm (Biochemistry, Virginia Tech)

SHUBHAM A. DAWDA
VIRGINIA TECH / ELECTRICAL ENGINEERING

Quantitative phase imaging of cellular response to electrical field

The goal of the project is to study the electrical properties of a biological sample using optical quantitative phase imaging. Electric fields have the potential to alter the physical properties of a biological sample, such as the refractive index, size and shape. These alterations can be used for various applications such as drug delivery and treating diseases such as osteoporosis. The non-invasive nature of this technique makes it better than invasive methods such as surgery. However, there is still much work to do in understanding how exactly a biological sample changes under the influence of an electric field. To gain a better understanding of what happens to a biological sample at the microscopic level, interferometry coupled with signal processing is used to create a quantitative phase microscope. An interferogram is obtained by using a Michelson interferometer by interfering the sample's optical field with a reference optical field. The spatial phase and amplitude of the sample field are modulated on the light reflected in the sample arm, which can then be demodulated from the interferogram. By subjecting the sample to DC or AC electric fields, we anticipate to quantify its morphological deformation and its dynamic behavior.

Mentor: Dr. Yizheng Zhu (Electrical and Computer Engineering, Virginia Tech)

TANNER J. DEAN
VIRGINIA TECH / BIOCHEMISTRY

Structure and Dynamics of c-myc G-Quadruplex

G-quadruplexes (GQs) are noncanonical nucleic acid secondary structures that form in guanine-rich sequences like gene promoters and telomeres. The guanines within GQs arrange in square, planar tetrads through Hoogsteen hydrogen bonding. These tetrads stack on top of one another to make a highly ordered structure with an electronegative core. Cations are required to stabilize these tetrads. GQs play important roles in gene expression and genomic stability and are found in many proto-oncogenes. The c-myc proto-oncogene is linked to many types of cancer. This feature makes the c-myc GQ a novel drug target for cancer therapy. While many GQs are biologically important, much is still unknown regarding their folding and stabilization. To gain atomistic insight into the structure and dynamics of the c-myc GQ, we performed molecular dynamics simulations with the CHARMM36 additive and Drude-2017 polarizable force fields (FFs). The classical Drude oscillator model explicitly accounts for induced electronic polarization by attaching negatively charged particles to all heavy atoms via harmonic springs. Inclusion of polarization alleviates some inaccuracy of additive FFs, which approximate average polarization through assignment of partial charges. These simulations of the c-myc GQ have provided insight into its stability, ion-base interactions, and the fluctuation of dipole moments, emphasizing the importance of explicit polarization in the structure and dynamics of GQs.

Mentor: Justin Lemkul (Biochemistry, Virginia Tech)

BRENNA V. DEBELLAS
VIRGINIA TECH / BIOLOGICAL SCIENCES

Discovery of a recently described mobile element in novel Mycobacteriophage Camri

Mycobacteriophages are genetically diverse viruses that infect bacteria in the Mycobacterium genus, which includes both Mycobacterium tuberculosis and M. smegmatis. Due to the continued increase of antibiotic resistance, researchers across the globe are revisiting old practices, such as phage therapy, to treat pathogenic bacterial infections. Understanding bacteriophage genetics is crucial in the development of these phage therapy treatments. The precise functions of the genes must be known in order to select the best phages to target each strain of bacteria. The aim of the SEA-PHAGES program is to discover and characterize novel bacteriophages using basic laboratory techniques and bioinformatic analyses to determine gene functions and find novel features within each genome. The goal of this project was to annotate the genome of novel bacteriophage Camri. Camri belongs to the G1 Subcluster and contains a unique genetic element only recently discovered in a small number of mycobacteriophages. Camri's genome contains a transposable element, better known as an ultra-small Mycobacteriophage Mobile Element (MPME), in the latter section where recombination typically occurs. The MPME in Camri's genome is relatively small in length and matches the MPME1 subcategory described in related phages. At this time, not much is known as to how these MPMEs specifically affect mycobacteriophage genomes, but they have been shown to alter gene regulation and expression in other organisms.

Mentor: Dr. Stephanie Voshell (Biological Sciences, Virginia Tech)

NICOLE M. DEFOOR
VIRGINIA TECH / COMPUTATIONAL & SYSTEMS NEUROSCIENCE

Synthetic Speech and its Effects of Human Trust

The goal of this project is to understand the relationship between computer generated speech and what, if any, effects it has on how humans trust and make decisions. Currently, artificial intelligence has been a hot topic in the field of ethics. A specific issue being people are arguing if it is moral to 'trick' a person into thinking they are conversing with another human, using technology like Google Assistant or Siri to make appointments and talk to humans in place of the user. The procedure for this study compares how synthetic and human voices impact how credible a speaker is perceived to be. Participants will rate how credible they believe a list of trivia statements to be from either a synthetic or human voice. The stimuli being used consists of 10 highly obvious true or false facts and 10 obscure true or false facts. 200 participants will be recruited to take an online survey in which they will listen to 20 trivia statements from a single "speaker"; our critical comparisons will be across participants. This study has been IRB approved and is beginning to collect data, but we anticipate data collection will be fast and that we will be able to present our first findings. Specifically, we will test whether the ratings of truth for the obscure facts are significantly different when listeners heard them from a human vs synthetic voice.

Mentor: Dr. Abby Walker (English, Virginia Tech)

TANNER G. DEHART
VIRGINIA TECH / BIOCHEMISTRY

Characterization of penicillin binding protein 2a in Borrelia burgdorferi, the causative agent of Lyme disease

Lyme's disease is the most common vector borne illness in the United States and is the result of infection with borrelia burgdorferi, a spirochetal bacterium. Like most bacteria, B. burgdorferi requires cell wall biopolymer peptidoglycan (PG), made from repeating sugar and peptide (PG) subunits, to survive. Penicillin binding proteins (PBPs) are essential for the growth and survival of bacteria, as they catalyze the synthesis of the PG backbone. As their name suggests, PBPs are also the target of antibiotic drugs. PBP2a is of particular interest in B. burgdorferi, as it has been shown to function in the presence of _-lactams in other bacteria such as Methicillin Resistant Staphylococcus aureus (MRSA), providing innate resistance to _-lactam antibiotics. Despite the importance of PG in the growth and division of all bacteria, in addition to its historical role in production of antimicrobials, nothing is known about its production in the Lyme disease bacterium. Perhaps even more striking is that two of the three drugs used to treat Lyme disease target PG synthesis, and yet we do not understand why or how they work. Here, we use molecular, cellular, surrogate-host, and biochemical tools to evaluate the function of a seemingly essential PG synthesis enzyme. Our studies will characterize the function of PBP2a to better understand its role in PG synthesis and antibiotic resistance/susceptibility.

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

HARPREET DHAMI
VIRGINIA TECH / BIOCHEMISTRY
MAGGIE KAUFFMAN
VIRGINIA TECH / EXPLORING LIFE SCIENCES
SOPHIE DESIMONE
VIRGINIA TECH / BIOCHEMISTRY
BAKER WHITE
VIRGINIA TECH / ANIMAL AND POULTRY SCIENCE

Measuring Radioactivity using a Geiger Counter

Students in the Curie and Da Vinci Living Learning Community collaborate on semester-long projects that promote development of skills associated with the practice of science. Our project involved building a Geiger counter and its housing unit using resources in our residential makerspace. This work enabled us to expand our academic, technical and teamwork skills. We learned academic concepts such as atomic theory, nuclear particle physics, properties of different chemicals and gases, behavior of wavelengths and frequencies, and the chemistry and physics inside of cathode. Wed developed technical skills such as circuitry, coding and the use of software such as R, MatLab, and 3D Computer Aided Design. We learned team skills such as conflict resolution and effective communication. After building the Geiger counter, we collected data about radiation levels detected on and around Virginia Tech campus, and used this data to visualize the level of radiation. We will present our findings, our Geiger counter, and our learning experiences associated with the project.

Mentor: Lori Blanc (Biological Sciences, Curie and Da Vinci LLC, Virginia Tech)

AVA DIVITA
VIRGINIA TECH / ENVIRONMENTAL SCIENCE
KAZ NOBUMOTO
VIRGINIA TECH / ENVIRONMENTAL SCIENCE
RACHEL ROSENQUIST
VIRGINIA TECH / ENVIRONMENTAL SCIENCE
SOHIS HAYES
VIRGINIA TECH / ENVIRONMENTAL SCIENCE

Mechanical Harming Effects on Mutant Versus Wild Type Arabidopsis Plants for Gene Function Determination

We participated in a citizen science project as part of the Da Vinci Living Learning Community experiential learning program. Our goal was to determine the function of a mutant gene in the Arabidopsis thaliana by applying a mechanical stress test on mutant and wild-type plants. We repeatedly subjected leaves of the Arabidopsis plants with varying intensities of harm using scissors to mimic damage caused by cabbage white caterpillars. We categorized sixteen Arabidopsis plants into five groups differentiated by harm intensity: slightly wounded, decently wounded, wounded, intensely wounded, and control (no wounding). The plants were placed under a constant grow light and were watered twice a week to keep the soil moist. We predicted that mutant plants would be under greater stress due to an inhibitor acting on the auxin gene, while the wild type should not be as impacted. This project will produce data that can help determine the function of the mutant gene in the Arabidopsis plant, which can then provide information on the role of the gene in other plants. We will present data from our experiment and discuss our roles and learning experiences from the project.

Mentor: Lori Blanc (Biological Sciences, Curie & Da Vinci LLC, Virginia Tech)

CAMILLE T. DO
VIRGINIA TECH / GEOSCIENCES

Correlation of Inorganic Carbon and Nitrogen Isotopes in the Ediacaran Sedimentary Basins

The Cambrian Explosion is a dramatic radiation in animal diversity. To understand this radiation, we must understand the environmental changes in the Ediacaran Period immediately preceding the Cambrian Explosion. The objective of this research is to study the geochemistry of the Ediacaran Doushantuo Formation black shales in China. The Doushantuo Formation records the Shuram Carbon Isotopic Anomaly, a global event of extreme 13C depletion and a vast reorganization of the carbon cycles. Black shales were chosen for this study due to their richness in organic material, which can be used to extract valuable information to improve stratigraphic correlation and to reconstruct environmental conditions. Total Organic Carbon content (TOC) and organic carbon isotope ratios will be measured on a mass spectrometer. TOC will be used to normalize Hg concentrations of the black shale to assist stratigraphic correlation and to track possible volcanic events. Volcanic ash tends to have high Hg concentrations, thus it will affect the Hg content of shales deposited during massive volcanic eruptions. Hg/TOC spikes would indicate past volcanic events. If such events were global, they can be used for global stratigraphic correlation to constrain the age and duration of the Shuram event and its environmental consequences. The data will help us better understand environmental and biological evolution on the eve of the Cambrian Explosion, a monumental milestone in the history of Earth and life.

Mentors: Shuhai Xiao and Morrison Nolan (Geosciences, Virginia Tech)

DARREN T. DOUGHARTY
VIRGINIA TECH / BIOCHEMISTRY
ALISA BONDAR
VIRGINIA TECH / BIOCHEMISTRY
CHRISTOPHER TAN
VIRGINIA TECH / BIOCHEMISTRY

Human tau isoform aggregation and using aggregated tau isoforms as new biomarkers for Alzheimer's disease detection

Alzheimer's disease (AD) is the sixth leading cause of death in the United States, the most common cause of dementia, and one of the most expensive diseases due to the intensive care needed for the patients and the lack of therapeutic drugs for treatment. A trademark of AD is the neurofibrillary tau protein tangles that damage neurons as they leave their native state to form the highly ordered tangles. To better understand the formation of these tangles, the six human isoforms of tau proteins were expressed using recombinant technologies and highly purified using biochemical chromatographic procedures. The purified human tau isoforms are aggregation-competent as shown in thioflavin T (ThT) fluorescence assays and are able to generate oligomers and material fibrils. We performed detailed analyses on the aggregation properties of the six human tau isoforms and discovered that the isoforms that have the R2 region (0N4R, 1N4R, and 2N4R isoforms) consistently took longer time to form amyloids than their counterpart lacking the R2 region (0N3R, 1N3R, and 2N3R variants). The results suggest that the R2 region plays an important role in the aggregation of these tau isoforms. We further discovered that all six tau isoforms are able to detect misfolded tau aggregates in Alzheimer's disease patient brain tissue samples using an ultrasensitive real time quaking-induced conversion (RT-QuIC) assay and our assay is able to differentiate AD vs. non-AD brain.

Mentor: Bin Xu (Biochemistry, Virginia Tech)

SALLY R. DUKES
VIRGINIA TECH / POLITICAL SCIENCE

Sheppard v. Maxwell Revisted

In writing the opinion of the court in the case Sheppard v. Maxwell, Supreme Court Justice Clark described the trial of Dr. Samuel Sheppard as possessing a "carnival atmosphere". This case is held up in journalism textbooks to be a primary example of the failure of the justice system, in part due to interference by the media and exemplifies the importance of distinguishing a line between a free press and a fair trial. While it is undeniable that the murder of Marilyn Sheppard attracted a vast amount of media attention, a letter signed by ten reporters of various publications who attended the trial contests the idea of a "carnival atmosphere" perpetuated by the media in the courtroom. In my research, I read through the complete coverage of the Sheppard murder trial, from voir dire to the announcement of the verdict, by two papers whose reporters did not cosign the letter in order to determine if the Supreme Court's judgement in that area was correct. Though I ultimately believe the Supreme Court to be correct in their final judgment, my examination of the Pittsburgh Post-Gazette and the St. Louis Post-Dispatch show that what in-court spectacle there was could overwhelmingly be attributed to the actions of the attorneys.

Mentor: W. Wat Hopkins (Communication, Virginia Tech)

KRISTINA EAST
VIRGINIA TECH / BIOMEDICAL SCIENCES
TRISHA DESHMUKH
VIRGINIA TECH / BIOLOGICAL SCIENCE

Engineering A Biomimetic Tumor Microenvironment To Study Patient-Derived Cell Interactions In Vitro

Primary cancer cells and circulating tumor cells (CTCs) have been established as diagnostic and prognostic tools. However, patient-derived biopsies are low in cell densities and culturing them is a technical challenge. The overarching goal of this study is to engineer a biomimetic tumor microenvironment to study immune-cell interactions with the tumor niche in vitro. Previous work has shown heparin hydrogel as a potential extracellular matrix for low-density cell culture using a triple negative breast cell line (TNBC), MDA-MB-231 and a TNBC CTC line from a Stage 2 breast cancer patient. To expand on this study, human mammary fibroblasts were co-cultured with cancer cells and their impact on tumor progression and viability is being assessed. Additionally, a microfluidic device was designed and engineered to successfully incorporate cells of the tumor stroma to study interactions with neutrophils from both young and elderly healthy volunteers. Future studies will aim to characterize tumor-associated neutrophils, as either anti-tumor (N1) or pro-tumor (N2). A nanoparticle-based biosensor for CD11b, an established biomarker for N2 will be developed to study relative receptor levels in the two volunteer populations in real-time, using the microfluidic device as a platform. The quantification of CD11b will provide insight into neutrophil regulation in aging populations and open new avenues for immunotherapy in cancer.

Mentor: Caroline Jones (Biological Sciences, Virginia Tech)

COURTNEY R. EBERSOHL
VIRGINIA TECH / HISTORY

“She would not go anyhow”: Freed Women in Post-Civil War Fairfax County (1865 - 1872)

How did black women envision freedom in the immediate aftermath of the Civil War? I employ Fairfax County in northern Virginia as a case study for analyzing freed women’s experiences of labor and family during Reconstruction. By examining Freedmen’s Bureau records, which include documents detailing daily activity, I explore freed women’s interactions with freed men, white southern men, and the Freedmen’s Bureau, focusing on how ideologies of gender and race shaped their experiences. Freed women demonstrated their resistance to white notions of black inferiority when they advocated for equal protection under the law through the Freedmen’s Bureau. Freed women struggled against white and black men, refusing to submit to their desires when compliance would mean outsourcing control of their children, or surrendering their humanity and womanhood. Freed women often used men’s expectations of male/female household roles to resist the aspects of each group’s vision of black emancipation that curtailed their vision of freedom. Although emancipation did not eliminate inequality and white violence, African American women persisted and asserted their free status by resisting white southerners’ threats against their families and to their economic independence. In the midst of white opposition to emancipation, a freed woman’s agency becomes more apparent during Reconstruction when she could more visibly enact her own definitions of freedom based on autonomous families and choice of labor.

Mentors: Dr. Daniel Thorp and Dr. Quigley (History, Virginia Tech)

COURTNEY R. EBERSOHL
VIRGINIA TECH / HISTORY
XAVIER PREVOZNIK
VIRGINIA TECH / HISTORY
CAROLYN BUONFORTE
VIRGINIA TECH / HISTORY
LIV WISNEWSKI
VIRGINIA TECH / HISTORY
GIA THEOCHARIDIS
VIRGINIA TECH / HISTORY

Enacting Freedom: Black Virginians in the Age of Emancipation

What did freedom mean to African Americans who lived in Virginia during the Civil War and its aftermath? A team of undergraduate researchers analyzed Freedmen's Bureau records to create an exhibit at the Appomattox Civil War Museum demonstrating general patterns and individual stories to reveal the different ways African Americans forged new lives outside of slavery. We found that the Freedmen's Bureau, formed at the end of the Civil War, was essential to connecting freed people to resources and helping them fight for recognition of their freedoms. Liberties denied to them during slavery, such as education, autonomous families, independent labor, and equal treatment by the law, were essential to their definitions of freedom. Freed people passionately supported their schools. A partnership between freedpeople, the Freedmen's Bureau, and northern philanthropic societies allowed black education to thrive. Marriage and family created a bridge between race and status. Freed or enslaved, African Americans fervently defended their right to experiences of marriage and family. The end of slavery provided former slaves the opportunity to find jobs. With few job prospects, many returned to former enslavers. Labor contracts between white and black people increased African American autonomy, but still legally bound them to the land they worked. African Americans fought to break the metaphorical chains that prevented them from having equal civil rights and engaging in democracy.

Mentor: Dr. Paul Quigley (History, Virginia Tech)

HANNAH-MARIE S. EDDINS
VIRGINIA TECH / ANIMAL AND POULTRY SCIENCES

First description of the hand and foot of a derived phytosaur from the Chinle Formation of New Mexico

There is a distinct difference in the ankle and foot between the two primary groups of archosaurs. In birds and their relatives, Ornithodira, there is a 'block-like' articulation, mesotarsal ankle, which restricts posture and movement of the limb. Crocodiles and their relatives, Pseudosuchia, contain a 'puzzle-piece', crurotarsal ankle joint which forms a heel. Over time, both of these groups also independently reduced the 5th digit of their hind foot. Using hand and foot morphology, especially the ankle, can help phylogenetic placement for Phytosauria, currently considered the closest relative of Archosauria, as well as assist in explaining ossification patterns of the wrists and ankles across reptiles. Currently, evolutionary knowledge is incomplete within this group due to a lack of specimens. Here we describe the right hand and foot of the well-preserved phytosaur Machaeroprosopus pristinus; it is missing the proximal and 5th tarsals along with all carpals, meaning it is possible these structures never ossified. The astralagus has a deep anterior hollow, unlike that of previously described phytosaurs and other pseudosuchians. These features confirm that phytosaurs are distantly related to their crocodile relatives, but additional comparisons are needed to confirm their relationships with Archosauria. The lack of ossified carpals and tarsals may indicate that cartilage was a critical factor in the morphology and functionality of the hand and foot.

Mentors: Michelle Stocker and Sterling Nesbitt (Geosciences and Paleontology, Virginia Tech)

ANNIE L. EICK
VIRGINIA TECH / PSYCHOLOGY

The Actively Caring for People (AC4P) Movement: Applying Behavioral Science to Improve Police-Citizen Relations

Current news portrays police officer-civilian relationships as uneasy at best. Thus, E. Scott Geller published a book, Actively Caring for People Policing: Building positive police/citizen relations, with Bobby Kipper (a former police officer for 25 years) which describes a program to promote positive police-civilian interactions. In the program, police officers wear blue Actively Caring for People (AC4P) wristbands and give them out to civilians as either feedforward or feedback. Examples of feedforward include the officer helping a civilian in some way and the civilian showing gratitude to the officer. For feedback, the AC4P wristband is passed on when the officer witnesses a civilian doing a kind act. To observe the interactions between civilians and police officers, research assistants participated in ride-alongs with officers at two different police departments in Southwest Virginia. The authors applied behavioral checklists to systematically record occasions when the observed police officer could offer feedforward or feedback. These ride-alongs provided data for 306 interactions between police officers and civilians with 89% being positive, 38% being feedforward, and 62% feedback. This indicates that there are many opportunities for AC4P wristbands to be passed on, which would increase positive perceptions of police officers in the communities sampled in Southwest Virginia.

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

DAVID ELLWOOD
VIRGINIA TECH / COMPUTATIONAL MODELING AND DATA ANALYTICS
CHAD KELLEY
VIRGINIA TECH / MATHEMATICS
ALEXANDER SHEVALIER
VIRGINIA TECH / MATHEMATICS
TUCKER LEBOR
VIRGINIA TECH / COMPUTATIONAL MODELING AND DATA ANALYTICS

Rocket Project

Throughout history, human beings have strived to reach the limits of the world that they live on. Modern knowledge regarding physics and construction have allowed humans to travel to space, the moon, and to explore other parts of the galaxy. In this spirit, we worked as a team to design and create a functional model rocket capable of reaching a large vertical altitude (preferably higher than 325 meters). The purpose of this project is to apply knowledge gained from science, math, and engineering classes to create a functioning model rocket. In particular, our goal was to obtain a glimpse of how scientists and engineers use the same concepts when creating rockets capable of traveling to outer space. We built the physical rocket using soldering, power tools, and a laser cutter, and used Arduino and Matlab/R to record data along the rocket's path. From this experience, we hope to better understand real world applications of scientific concepts learned in the classroom.

Mentor: Lori Blanc (Biological Sciences, Curie and Da Vinci LLC, Virginia Tech)

NATHANIEL C. ESTEVES
VIRGINIA TECH / MICROBIOLOGY

Investigation of factors influencing flagellotropic bacteriophage lysis patterns

Bacteriophages, viruses that attack bacteria, are found in many different niches including human intestinal flora. Bacteriophages have very specific host ranges and binding mechanisms. Flagellotropic bacteriophages are phages that infect only motile bacteria and do so by binding to rotating flagellar filaments. Filaments must be actively rotating for infection to occur. In this study, we used phage drop assays to investigate factors influencing the pattern of phage-mediated bacterial lysis. For each experiment, Salmonella enterica subsp. enterica serovar Typhimurium strain 14028s was inoculated with flagellotropic bacteriophage Ï‡ on swim plates. The low agar concentration in swim plates allows for the formation of a swim ring, corresponding to motile bacteria swimming through the medium. Various factors hypothesized to impact the lysis pattern were altered in separate trials. We determined that virus titer, nutrient concentration, multiplicity of infection, configuration of phage inoculation, and deletions of bacterial chemoreceptor genes all play a role in determining the pattern of lysis. These results help elucidate the poorly understood dispersal mechanism of bacteriophage viruses in various microbiological environments.

Mentor: Birgit Scharf (Biological Sciences, Virginia Tech)

OLIVIA EVANS
VIRGINIA TECH / MICROBIOLOGY
GABBY TURNER
VIRGINIA TECH / ANIMAL AND POULTRY SCIENCES
LINDSEY THOMPSON
VIRGINIA TECH / BIOLOGICAL SCIENCES
JILLIAN HOWE
VIRGINIA TECH / BIOLOGICAL SCIENCES
SIERRA ROTH
VIRGINIA TECH / MICROBIOLOGY

Model of a Ruminant Stomach

As students in the Curie and Da Vinci Living Learning Community, we were tasked with completing a semester-long collaborative project. The goal of this team-based project was to create a visual model that accurately and clearly describes the structure, function, and cyclical flow through the stomach of a ruminant. To achieve this goal, we started by learning about each compartment of the stomach and creating physical sketches that depict the structure of the stomach and the flow through each compartment of the stomach. We used Computer Aided Design software to create sketched images compatible with a laser cutter, and imported these sketches into Rhino software to create a template for laser cutting the image on acrylic sheets. This process resulted in a two-panel model. The first panel depicts the structure of the organ and descriptions of the function, and the second panel depicts the flow through the organ. We will present the final product and discuss our learning process.

Mentor: Lori Blanc (Biological Sciences, Curie and Da Vinci LLC, Virginia Tech)

HANNAH M. FLAVIN
VIRGINIA TECH / PSYCHOLOGY
TREVIN GLASGOW
VIRGINIA TECH / GRADUATE STUDENT

The Impact of Daily Technology Use on Psychological Health and Well-Being: A Multi-level Approach

Digital technology (e.g., smart phones, computers, and video games) have dominated our culture, and can impact the well-being of technology users. Given the increasing use of technology among college settings, a better understanding of how technology use affects the well-being of college students is critical. The following hypotheses were tested: 1) Daily technology use is negatively associated with daily positive affect, and 2) Neuroticism is positively associated with use of social media. Participants (n=177) were recruited through SONA, which is the extra credit system for students enrolled in psychology courses. On Monday of the first week of the study, participants completed a Qualtrics survey assessing their typical use of technology, well-being and certain personality traits (i.e., from the Big Five). From Tuesday to Sunday, participants completed a survey each night assessing: a) positive affect, b) daily technology usage, and c) daily physical activity. Relationships between technology use, personality and well-being were investigated empirically. Individuals who sent more text messages had less daily positive affect; however, those who used their phone for other reasons, such as browsing the Internet, had more daily positive affect. Neuroticism was positively associated with daily social media usage.

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

CAROLINE FLYNN
VIRGINIA TECH / CREATIVE TECHNOLOGIES IN MUSIC

Pulling at the Heartstrings

Heart disease is the leading cause of death for both men and women, accounting for 1 in 3 deaths. New treatments for heart disease have plateaued over the last two decades, and new pharmaceutical therapies to improve cardiac function are needed. A major limitation to discovering new therapies that can improve heart cell function is the lengthy time for drug discovery, screening, and development. Pulling at the Heartstrings aims to create a completely new approach to understanding cell behavior. By combining disciplines in bioenergetics, engineering, and creative technologies in music, we are pioneering a new Cellular Stethoscope to advance drug testing beyond the visual interpretation of cellular responses using sonification. Sonification, or the use of audio to convey data, of cell behavior allows for the rapid recognition of behavioral patterns that can be related to responses to drug therapy. The system created through this interdisciplinary collaboration will be an easily understandable, high-throughput method to screen novel drug therapies to mitigate burdens associated with heart disease.

Mentor: Ico Bukvic (Creative Technologies in Music, Virginia Tech)

CLARA L. FRAZIER
VIRGINIA TECH / BIOCHEMISTRY

A proteomics approach to quantifying vitellogenin in the eastern hellbender (Cryptobranchus alleganiensis)

The eastern hellbender (Cryptobranchus alleganiensis) is an imperiled aquatic salamander native to the eastern United States. Understanding the reproductive physiology of the eastern hellbender is vital to their conservation. Vitellogenin is a phospholipoglycoprotein synthesized in the livers of female vertebrates and delivered to developing ovarian follicles where it is cleaved into several yolk proteins essential for embryonic development. Since hellbenders are seasonal breeders, measuring seasonal variation in plasma vitellogenin concentrations can provide important insights into female reproductive cycles in the eastern hellbender. Vitellogenin has previously been detected in eastern hellbender plasma but the variation throughout the reproductive cycle has not yet been elucidated. In this study, we use an LCMS proteomics approach to quantify vitellogenin in female eastern hellbender plasma. We expect that circulating vitellogenin levels will gradually increase in the months leading up to oviposition and peak just prior to oviposition in early September.

Mentors: Dr. Rich Helm (Biochemistry, Virginia Tech, Virginia Tech), Dr. William Hopkins (Fish and Wildlife Conservation, Virginia Tech)

MORGAN GALLAGHER
VIRGINIA TECH / ENVIRONMENTAL SCIENCES

Towards an Understanding of Dissolved Methane Dynamics in Oxic Streams

Most freshwaters are sources of greenhouse gases, such as methane (CH4), to the atmosphere. However, much of the CH4 dynamics, including temporal patterns, sources, and isotopic composition remain unexplored, particularly in streams. Developing a mechanistic understanding of CH4 within running waters is critical to enhance our knowledge of these fluxes and improve our capacity to predict their future change. Stroubles Creek in Blacksburg, Virginia, is a persistent source of CH4 to the atmosphere. To better understand the processes controlling CH4, we quantified (1) potential CH4 water column production rates and (2) temporal changes in concentration and source variation. In laboratory bioassay experiments, CH4 concentration decreased over time, suggesting processes in the water column were not contributing to CH4 supersaturation. We deployed a logging CH4 sensor to record concentration over a two-month period (logging frequency = 0.5 hr) in the field, where the in-stream CH4 concentrations ranged from 240 - 395 ppm (CH4 atmospheric concentration is ~2 ppm). CH4 concentrations were highest at night and lowest during the day. Ongoing work is using stable isotopes to identify different sources contributing to CH4 production and loss within 24-hour periods. Results from these experiments offer a new perspective on methane dynamics; such information is crucial to allow for better estimates of our global carbon budget.

Mentor: Erin Hotchkiss (Biology, Virginia Tech)

ALYSSA E. GENTRY
VIRGINIA TECH / MECHANICAL ENGINEERING

Investigation of Ultrasound Shear Wave Elastography for Treatment Feedback during Focused Ultrasound Ablation

Histotripsy is a non-invasive and non-thermal focused ultrasound ablation modality that disintegrates a target tissue using a cavitation bubble cloud induced by high negative-pressure ultrasound pulses. Histotripsy's effectiveness has been observed to be dependent upon tissue mechanical properties. For the current study, we investigated the utility of ultrasound based shear wave elastography (SWE) in categorizing tissue stiffness in terms of their shear modulus. We hypothesized that shear modulus calculated by SWE would directly relate to the effectiveness of histotripsy ablation. The results found that porcine kidney had a stiffness of 15.5kPa (STDEV 4.05). These values are significantally ($p<0.05$) lower than the stiffness measured for porcine stomach (49.8kPa, STDEV 6.57) as well as the small and large intestines (47.0 and 47.2kPa, STDEV 3.99 and 8.86, respectively). To add a clinical application to this work, we also investigated 3 different types of human liver tumors harvested under IRB approval. The primary liver tumor, cholangiocarcinoma tumor, and metastatic colon tumor were all found to have stiffness values between 20-25kPa making these tumor types treatable with histotripsy. Overall, these suggest that SWE can be a useful method for planning and monitoring histotripsy proceedures in different tissue types. In the future, we plan to complete a collection of SWE data for different tissues and correlate results to the tissue susceptibility to histotripsy ablation.

Mentor: Dr. Eli Vlaisalvjevich (BEAM, Virginia Tech)

SOFIA M. GHANI
VIRGINIA TECH / HNFE

Do those carrying the variant genotype of rs12970134 on the Melanocorpin 4-Receptor gene have a higher BMI?

This research aims to identify the polymorphic effects of the Melanocorpin 4-Receptor Gene (MC4R), specifically its SNP, rs12970134. The MC4R gene is responsible for numerous functions, but specifically for regulating a person's metabolic rate.The mutative effects of rs12970134 can be exhibited by having a larger waist circumference than average, which can lead to a higher BMI and an increased risk of various cardiovascular diseases. In this study, genetic data was collected from Virginia Tech volunteer student samples by utilizing the popular service, 23andMeTM. Spit samples were collected and DNA was extracted, and primers were designed for PCR genotyping analysis. The results of the PCR reactions on genmoic DNA, as well as the in silico analysis on raw data from 23andMe, will be used to test the hypothesis that individuals carrying the mutated allele combinations for rs12970134 will exhibit higher rates of BMI, as reported on student surveys.

Mentors: Deborah Good and Angela S. Anderson (HNFE, Virginia Tech)

MADISON GONZALEZ
VIRGINIA TECH / ANIMAL AND POULTRY SCIENCE

Citrulline supplementation as a means to improve post-exercise muscle recovery in horses

Thoroughbred racehorses expend in excess of 30,000 calories in a single bout of exercise which causes depletion of energy stores and microdamage to the muscle fibers. Satellite cells, the requisite stem and progenitor cells of skeletal muscle, are required for damage repair and regeneration. Recent evidence demonstrates that the activity of these cells can be modified by dietary supplements. L-citrulline is a non-essential amino acid that improves human exercise performance. The objective of the study was to determine whether citrulline fed to adult Thoroughbreds would improve recovery from a single bout of acute exercise. Horses were fed a control or citrulline supplemented diet for 3-wks prior to performing a standard exercise test (SET). Heart rate was monitored throughout the SET and blood was collected immediately after for determination of exercise stress. Muscle biopsies were retrieved for 5 days during the post-SET recovery period for examination of repair and energy repletion. No differences in either plasma lactate, packed cell volume or heart rate was found between control and citrulline fed horses suggesting that the amino acid does not enhance performance. Measurement of glycogen content before and 24-h after the SET were not different indicating that the horses did not rely upon anaerobic energy stores. PGC1, a transcription factor involved in muscle repair, was increased in response to exercise but unaffected by citrulline supplementation.

Mentor: Sally Johnson (APSC, Virginia Tech)

JULIA N. GOYER
VIRGINIA TECH / MATERIALS SCIENCE AND ENGINEERING

Exploring Solvent Mixtures and Particle Interactions for Near-Net Shaping of Ultra High Temperature Ceramics

In this research, the use of various organic solvents as well as co-solvent mixtures in colloidal processing routes of zirconium diboride, and their relationship to the dispersion quality of the resulting suspension, is examined. Colloidal processing routes such as slip casting and gelcasting are used for the experiments with the intention of near-net shaping of Ultra High Temperature Ceramics in thermal protection systems of hypersonic vehicles. The green density is maximized to encourage high thermal conductivity and re-radiation of heat in the leading edges, protecting inner components. Suspension stability, which directly influences the uniformity of the finished component, was considered. Detailed flow behavior of suspensions was characterized using a rheometer. Low viscosity slurries were obtained with slip casting suspensions at approximately 40% solid loading with cyclohexane, demonstrated to be viable in previous works, as well as tetrahydrofuran (THF) and dimethylformamide (DMF). Shear thinning behavior was observed in all three cases in which the suspension was sufficiently low viscosity to be poured. The theoretical performance of each suspension, based on interparticle interaction energies, was compared to the empirical results, and the relationship between interaction energy and viscosity as examined by previous works is explained. Cyclohexane proved to be the best slip casting solvent while gelcasting required THF as a cosolvent.

Mentor: Carolina Tallon (Materials Science and Engineering, Virginia Tech)

BETHANY K. GROCOCK
VIRGINIA TECH / HUMAN DEVELOPMENT
KATHRYN R. JOHNSON
VIRGINIA TECH / HUMAN DEVELOPMENT
ASHLEIGH M. BEDWELL
VIRGINIA TECH / PSYCHOLOGY

Information Seeking From Human, Printed, and Digital Sources

We learn information from many sources including books, humans, and the internet. Often times, these sources provide conflicting information; thus, selecting a reliable source is critical for effective learning. When given the option of multiple sources providing conflicting information, which source will adults choose to get information from? Prior research revealed that adults were more likely than children to select technology over a human, suggesting adults had a strong preference for technology (Noles et al., 2015). Another study found that the more exposure one has to text, the more likely they will use information from text than a human (Robinson et al., 2013). While these studies showed adults' selective information seeking, the range of information sources was limited. We will examine adults' preference on a wide range of sources including Smartphones. Fifty adult participants will be recruited from Amazon Mechanical Turk. Participants will watch four videos, each depicting two informants using one of the four information sources: smartphone (internet), laptop (internet), book, and phone call (human) to find a label for a novel object. After viewing each video, participants will be asked to endorse one of the two conflicting labels. We hypothesized that adults will prefer (1) internet over human, (2) internet over book, and (3) book over human informants. Data collection is in progress, and data will be analyzed using Chi-square and logistic regression.

Mentor: Koeun Choi (Human Development, Virginia Tech)

HAILEY GROFF
VIRGINIA TECH / CLINICAL NEUROSCIENCE
TARYN HOUGHTON
VIRGINIA TECH / NEUROSCIENCE
GRACE HECKER
VIRGINIA TECH / ANIMAL AND POULTRY SCIENCE
ELIZABETH BARRY
VIRGINIA TECH / ANIMAL AND POULTRY SCIENCE
EMMA TURTON
VIRGINIA TECH / NEUROSCIENCE
ZACH KIRKPATRICK
VIRGINIA TECH / ANIMAL AND POULTRY SCIENCE

Tongue Anatomical Model, Through The Process

The Curie and Da Vinci Science Living Learning Community tasks first-year students to complete a semester-long collaborative project that provides students with experience in solving problems that arise during completion of a complex task. The goal of our project was to create two acrylic anatomical models and learn how to communicate effectively to solve problems through hands-on experiential learning. To create the anatomical model, we used Rhino software to draw organs, which were then laser cut on acrylic panels. These colored acrylic panels were screwed together to produce the finished product. We will present two panels, one with a tongue diagram and one with a diagram of a tastebud, and discuss the experiences that each of us have gained throughout the process of creating this anatomical model project.

Mentor: Lori Blanc (Biological Sciences, Curie and Da Vinci LLC, Virginia Tech)

JILL I. GRZELAK
VIRGINIA TECH / BIOLOGICAL SYSTEMS ENGINEERING
ISHA REGE
VIRGINIA TECH / BIOLOGICAL SYSTEMS ENGINEERING

Future Climate Change Projections in Virginia

The main challenges related to climate change that are faced by the people in Virginia include increases in sea level, flooding, and temperature. These can have hazardous consequences and can negatively affect environmental systems and safe living conditions. To research the local impacts of climate change, the purpose of our project is to download, process, and analyze climate data from 1981-2005 in Virginia in an effort to predict possible future climate change. This can allow the population to better prepare for future weather conditions. Specifically, we have analyzed precipitation and temperature averages using historical simulation data from the OpenNEX climate data portal. With the functions of Matlab, this data was manipulated to be clearly analyzed and easily compared between each of the 21 Global Climate Models (GCMs). The goals of the project include the evaluation of projected changes in both variability and intensity in temperature and rainfall in order to understand climate change in future years. Additionally, we will summarize how future projections vary across different climate models in the NEX-GDDP ensemble and this will be used to determine the most accurate GCM. Currently, we are analyzing the climate model simulations for the upcoming century, i.e. up until 2100, using the several different GCMs based on different future scenarios. This project would aid decisions in agricultural production and construction projects when factoring in climate variability.

Mentors: Dr. Julie Shortridge (Biological Systems Engineering, Virginia Tech), Julia Reis (Biological Systems Engineering Ph.D Student, Virginia Tech)

SARAH E. HACK
VIRGINIA TECH / INDUSTRIAL AND SYSTEMS ENGINEERING
CHRIS J. DICKENSON
VIRGINIA TECH / INDUSTRIAL AND SYSTEMS ENGINEERING

Adolescent Risk Naturalist Driving Study

Adolescents' engagement in health-risk behaviors are associated with significant morbidity and mortality rates. According to the CDC, health risk-behaviors resulting in unintentional injury are among the top six health-risk factors among teens with motor vehicle crashes being the leading cause of injury and death among this age group. Naturalistic Driving Studies provide a novel solution to obtaining objective measures of risky behaviors, such as risky driving, among teens. Their results found that there were several predictors of risky behavior for novice teen drivers. This study serves as a 'proof of concept' for assessing objective measures of risk that can be used to compare and support neurobiological and psychosocial measures of risky adolescent behavior. The main research question for this study is "Does the prevalence of seat belt use change with varying lighting conditions and surface conditions?". Data coding was performed using Fauxcus Software. Statistical analysis was then performed using data visualization software. When road conditions have potential to be higher risk, or when the lighting conditions are darker or made it harder to see the road, the more inclined the driver is to use the seatbelt. In conclusion, for adolescents, the more risk associated with the driver's situation, whether it be caused by a secondary task engagement by the driver, lighting, or surface conditions, the more likely the driver is to use their seatbelt.

Mentor: Dr. Charlie Klauer (Human Factors Engineering and Ergonomics, VTTI)

THOMAS N. HALE
VIRGINIA TECH / POLITICAL SCIENCE

Decoding China-Pakistan Economic Corridor (CPEC) Messaging: A Reality Check

China's Belt and Road Initiative (BRI) creates a framework for fundamental development and strategic changes across South and Central Asia. Out of this bold initiative grew the China-Pakistan Economic Corridor (CPEC). CPEC is oriented towards strengthening relationships between Pakistan and spurring sweeping changes vital to China's influence in the region. While marketed towards mutual cooperation and development, scholars and analysts see this as a bold geopolitical move for Chinese influence in the region. This paper will investigate the messaging that has been produced by the Chinese government on CPEC projects and provide a strategic understanding to the new era of Chinese public diplomacy. Comparing CPEC messaging to on the ground reporting shows a darker reality which challenges Chinese narratives. While the US is aware of these issues, providing a counter narrative is difficult, especially in a time of reduced relations between the US government and the people of Pakistan. China has leveraged this struggling relationship and is becoming the main actor for the Pakistani government to fill the void left by the current administration's rhetoric. The strategic implications of CPEC and the broader Sino-Pak relationship has severe implications in the US Indo-Pacific strategy and the role China public diplomacy plays in South Asia.

Mentor: Dr. Yannis Stivachtis (International Studies, Virginia Tech)

REBECCA K. HAWKINS
VIRGINIA TECH

A Tale of Natural History Collections Education at Virginia Tech

The Natural History Collections Club (NHCC) was founded at Virginia Tech during the fall of 2017 with assistance from the Natural History Collections Club Network. The primary purpose of the club is to increase student awareness of natural history collections on and around campus. After two years of operation, the NHCC has met that goal with considerable success through collection tours, workshops, volunteer activities, outreach, and social events. As proof of that success, many members have gone on to conduct research in club-associated collections and participate in internships at collections around the country. Furthermore, the NHCC has served as a valuable avenue for increasing collaboration among curators on campus. This growing interest in collections at Virginia Tech has even produced a natural history collections and curation course for the spring of 2019. Students in the course learned collection principles and curation techniques, then worked with campus curators to complete collections-based projects. In just two years, the NHCC has progressed from uncertain beginnings to transforming the culture of campus collections and invigorating collection use in courses. We hope that other institutions can learn from our experiences and start their own natural history collections movements.

Mentor: Dr. Carola Haas (Fish and Wildlife Conservation, Virginia Tech)

ELIZABETH G. HAYES
VIRGINIA TECH / CSNU
JUSTIN C. MCKINNEY
VIRGINIA TECH / BIOC
EVAN S. RICHARDSON
VIRGINIA TECH / BIOC
JOHN B. WARREN
VIRGINIA TECH / BIOC

Examining the Effects of Mutations of Amyloid Beta(A_) on Neurodegenerative Disease Pathology Using Molecular Dynamics (MD) Simulations

Intrinsically disordered proteins (IDPs) are a class of proteins that have no defined secondary/tertiary structure. IDPs play a major role in many diseases, including Alzheimer's Disease (AD), Type 2 Diabetes, and Parkinson's Disease. In order to gain better insight into the structure, folding, and role of familial mutations on these processes, assessment of features at the atomistic level are essential. In this work, amyloid-_ (A_42), an IDP which plays a dominant role in AD, was investigated using molecular dynamics simulations to assess the role of force fields and mutations on the folding of a monomer of A_42. This work studies the mutations E22G, E22K, and D23N, which have been observed to phenotypically cause early-onset and more severe symptoms with AD. Assessment of secondary structure, residue-residue interactions, and overall residue stability were performed to determine the role of these mutations in on-pathway events in the aggregation process of AB42. Results indicate that the E22K mutation had the highest tendency to maintain _-helix structure, followed by the wildtype. Additionally, the E22G and D23N mutations had lower potential to maintain Î±-helical structure and demonstrated more _-strand structure, which is indicative of aggregation events for A_42. Collectively, this work aims to examine the differences in secondary structure formation between different mutations of AB and how different parameters for the motion of atoms impacts these secondary structures.

Mentors: Dr. Anne Brown and Dr. David Bevan (Biochemistry, Virginia Tech)

SARAH L. HEINE
VIRGINIA TECH / HNFE

Vitamin D Receptor: rs2228570

The Vitamin D receptor (VDR) is a nuclear hormone receptor that mediates the transcription of target genes linking to several metabolic pathways, including those in association with, bone mineral density, immune responses and cancer. Several single nucleotide polymorphisms (SNPs) within the VDR gene have been analyzed in an attempt to link variants and coding regions to alterations in the functioning of VDR. A SNP in the start codon signals translation to begin three codons downstream of the original translation start site, creating two isoforms of the protein. Variants in this region can be determined by using the restriction enzyme FokI on PCR amplified genomic DNA. When both start sites are present (called the "f-allele"), translation will begin at the most upstream start codon. However, when a variant is present in the original start codon region ("F-allele"), translation will begin downstream, producing a VDR protein three amino acids shorter. These variants change functionality, of VDR, with the F-VDR genotype functioning more efficiently than the f-VDR genotype. This study aims to evaluate the frequency of FokI polymorphism genotypes in relation to individual's health and ancestry. After using PCR, restriction enzyme treatment and gel electrophoresis, DNA results will be compared to survey questions answered by participants.

Mentors: Deborah Good and Angela Anderson (Human Nutrition, Foods, and Exercise, Virginia Tech)

JACOB S. HELMANN
VIRGINIA TECH / BIOLOGY

Exploring Dispersal and Genetic Connectivity Through a Newly Discovered Arizona Treefrog Population

The survival of a population, even that of a species, can depend on certain population genetic components, especially diversity, connectivity, and structure. For that reason, population genetic studies can provide beneficial guidelines for conservation and management actions when attempting to manage species in the face of climate change. The Huachuca Mountains and Canelo Hills of Arizona are home to isolated populations of the Arizona Treefrog, Hyla Wrightorum, a species of conservation concern. These isolated populations are morphologically and genetically unique, and they face threats from invasive species, human water use, fires, and climate change. Understanding the population genetic attributes of these unique populations is crucial for guiding conservation efforts in this region. In 2018, DNA was collected from individuals from a previously unsampled population, discovered only in 2015; the new population is geographically isolated from other previously studied populations. This new population may provide insight into the dispersal dynamics of this species in this region. Individuals will be genotyped and analyzed to determine similarity and connectivity to other populations. This project will help us understand the basic and applied ecology of this potentially vulnerable group of frogs.

Mentor: Meryl Mims (Biology, EEB, Virginia Tech)

SIERRA J. HENNESSY
VIRGINIA TECH / PSYCHOLOGY

Exploring Parent Stress and Restricted Repetitive Behaviors in ASD

Restricted, repetitive behaviors (RRBs) are symptoms that are often associated with persons diagnosed with Autism Spectrum Disorder. They most commonly range from stereotypical body movements (hand flapping and rocking back and forth are examples) to more general rituals of behavior, or restricted interests (Lewis & Kim, 2009). Previous research has indicated that when parents reported increased levels of RRBs in their children with ASD, it followed that caregiver stress also increased (Harrop, 2016). We examine whether parent stress levels were correlated with the number and frequency of RRBs in their children diagnosed with ASD. Participants included 13 children (1 girl and 12 boys) with ASD between the ages of 2 and 6 and their parents. All participants were seen at the VT Autism Clinic for 3 hours as part of an intake for a larger treatment study. Parent stress levels were measured through three different variables using three subscales of the Vineland-3, Life stress, Total stress, and Depression (Sparrow, 2016). RRBs were measured using the total score of the RBS-R (Lam, 2007). It was hypothesized that, consistent with previous literature, higher parent stress would be related to higher RRBs. We conducted correlations between RRBs and the three parent stress variables. Significant positive correlations were found between RRBs, Total stress ($p = .003$), and Depression ($p = .039$), such that parental stress increased as RRBs increased.

Mentor: Angela Scarpa-Friedman (Psychology, Virginia Tech)

CONNOR HERRON
VIRGINIA TECH / MECHANICAL ENGINEERING

Low Level Controller Hardware & Software Design and Implementation for a Robotic Humanoid Leg

This project focuses on designing software and hardware in order to properly control several actuators on a robotic humanoid leg. Absolute and incremental encoders are used to know the relative angle of the joints of the leg. Linear force sensors are used to calculate the relative torque of an individual actuator. The software is run on two TIVA micro controllers by Texas Instruments, where one communicates with the actuator at the thigh, and the other communicates with the two actuators at the ankle. The micro controllers communicate with the high level controller in Matlab using serial communication. The control loop process starts from a set of desired torques from the high level controller (Matlab) which is sent to the low level controllers (TIVA). The low level system has approximately 50 ms (20 Hz) to stabilize at these desired torques and achieves this using PID control loops. The absolute encoder angle values are then fed back to the high level controller in order to calculate the next set of desired torques. The high level controller settles to a stable torque value once leg is in a straight upright position.

Mentor: Alexander Leonessa (Mechanical Engineering, Virginia Tech)

SOFIA E. HIRT
VIRGINIA TECH / PSYCHOLOGY

Cognitive complexity and internalizing symptoms in adolescence: Moderation by adolescent sex

Cognitive complexity (CC) is presumed to reflect the intricacy of an individual's cognitive system and influences social perception and social interactions. High CC is related to the ability to identify more and less emotionally supportive messages and may play a protective role in regard to internalizing symptoms. Adolescence is a time of greater risk for internalizing symptoms, especially for girls. This study examined adolescent sex differences in CC and in associations of CC with internalizing symptoms (anxiety and depression). Twenty-eight adolescents (range = 13 - 18 years; 64% girls) participated with a parent and friend as part of a larger study. Youth, parents, and friends reported on the target youth's anxiety and depression symptoms on standard questionnaires. Target youth presented a five-minute speech about their own flaws, from which CC was coded. Coders identified 8 dimensions of CC, including multiple perspectives, comparisons, contrasts, evaluation, abstract ideas, references to time, distinct ideas, and global score. Using multivariate regression, it was found that there was a trend for girls to be higher in global CC than boys. While CC was not associated with anxiety in boys and girls, higher CC was related to lower levels of depression for boys, and to higher levels of depression for girls. Results suggest that CC functions differently for boys and girls with respect to depressive symptoms. Further research is needed to connect CC to psychopathology.

Mentors: Rachel Miller-Slough (Postdoctoral Fellow, Psychiatry and Behavioral Sciences, Duke University Medical Center), Julie Dunsmore (Psychology, Virginia Tech)

SARA HONAKER
VIRGINIA TECH / BIOCHEMISTRY
ERIC MASSOF
VIRGINIA TECH / BIOCHEMISTRY
IAN HICKLIN
VIRGINIA TECH / BIOCHEMISTRY
MAEGAN GABBY
VIRGINIA TECH / BIOCHEMISTRY

Geiger Counter

The goal of this project is to build a case for a Geiger counter in order to gather and analyze radiation levels from different areas across campus, primarily focusing on Robeson Hall, Lee Hall, Lavery Hall, and the tunnels beneath Hahn Hall. This project is being carried out as part of our involvement in the Curie and Da Vinci Living Learning Community First Year Experience. The purpose of this project is to apply learned concepts of nuclear particle physics, circuit building, coding, and the properties of different chemicals and gases to see how measured background radiation levels vary throughout campus. The measured radiation levels can then be used to determine how safe the various locations are for students. We made an acrylic case to hold a prefabricated Geiger counter. We used the computer software, Rhinoceros 6, to design the case and we utilized a laser cutter to cut the acrylic and form the sides of the case. We then visited the several predetermined locations around campus and used the Geiger counter to test the radiation levels at the various locations. The anticipated outcome for this project is to determine the radiation levels in various areas that are usually heavily populated by students. From this collected information, it will be possible to compare background radiation levels between tested areas. We anticipate the radiation levels being within normal limits. We will present our data, analysis, and the perspectives and experiences of each group member.

Mentor: Lori Blanc (Biological Sciences, Curie and Da Vinci LLC, Virginia Tech)

DEXTER W. HOWARD
VIRGINIA TECH / WATER: RESOURCES, POLICY, AND MANAGEMENT

Identifying the drivers of organic carbon in drinking water reservoirs to improve water quality

Organic carbon (OC) in drinking water reservoirs can lead to formation of disinfection byproducts (DBPs), potentially carcinogenic compounds formed when disinfectants such as chlorine react with OC in the water. Biodegradable dissolved OC (BDOC) is a fraction of dissolved OC (DOC) which may be especially reactive in the water treatment process as a DBP precursor. DBPs can increase when OC levels rise due to spikes in algae, turbidity, or other factors. We examined OC dynamics over space and time to determine the primary drivers of DOC and BDOC concentrations in two drinking water reservoirs owned by the Western Virginia Water Authority in Roanoke, VA during summer 2018. We collected fortnightly water samples of DOC and sensor profiles of algal biomass, turbidity, dissolved oxygen (DO), and temperature at multiple depths in each reservoir. For each sample, half the sample volume was incubated for 28 days to determine BDOC concentration, calculated as the difference in DOC concentration before and after incubation due to microbial respiration. We used linear models to correlate drivers to DOC and BDOC. Dissolved oxygen was positively correlated with DOC and BDOC, while temperature and turbidity were negatively correlated with both response variables. Our results indicate that DO, temperature, and turbidity are drivers of DOC and BDOC concentrations and that potential DBP precursors in our study reservoirs may be highest when temperature and turbidity are low and DO is high.

Mentors: Cayelan Carey (Biological Sciences, Virginia Tech), Mary Lofton and Ryan McClure (Biological Sciences Graduate Students, Virginia Tech), Barbara Niederlehner (Biological Sciences Senior Laboratory Specialist, Virginia Tech), Madeline Schreiber (Geosciences, Virginia Tech), John Little (Civil and Environmental Engineering, Virginia Tech)

RENEE N. HOWARD
VIRGINIA TECH / ENVIRONMENTAL PLANNING AND POLICY
BENJAMIN L. BOWMAN
VIRGINIA TECH / ENVIRONMENTAL RESOURCE MANAGEMENT

Effects of EarthGuard Pellets from the Mountain Valley Pipeline on Regional/Area Water Quality and Organic Farms

The Mountain Valley Pipeline project was founded in 2014 with the intention of bringing natural gas through West Virginia and southwest Virginia from the Marcellus and Utica shale sites. The project has received pushback from local communities with concern regarding the scope of eminent domain, implications on area water quality, and the impacts on local farms. The objective of this project is to investigate the communities impacted by the construction of the Mountain Valley Pipeline and the socioeconomic and environmental impacts on regions in the area, particularly local farmers. Supporters of this project state that the pipeline will be a needed source of energy supply to the southern-Atlantic region. In addition, the project aims to bring jobs to rural regions in Appalachia. In contrast, those that oppose the project claim that the company has not followed through with compliance regulations in regards to the EarthGuard pellets air dropped by helicopters to prevent soil erosion by construction area. Controversy has arisen from the location of the pellets varying greatly from the application sites, as well as the chemicals in the EarthGuard product. During this study we will interview people in the impacted areas including local farmers and residents and test water quality using macroinvertebrate and chemical monitoring in order to analyze impacts on members of communities and environmental health.

Mentors: Dr. Jennifer Lawrence (Post-Doctoral Research Associate, The Global Forum on Urban and Regional Resilience, Virginia Tech), Dr. Cermetrius L. Bohannon (Leadership and Social Change Residential College & Landscape Architecture, Virginia Tech)

HARLEY D. HUFFMAN
VIRGINIA TECH / SOCIOLOGY

Reminiscing on a Proverb "Kill Your Heroes": Re-Imagining Theory in the 21st-Century and Dismantling The Logic of Practice Through the Ways of Liminality

On Earth, the relationship between consciousness and humankind can perhaps be thought of as a doubling-back from the piths of human habits and the place of their space. This analogy silhouettes the premise for Pierre Bourdieu's project in The Logic of Practice. In the realms of Sociological Theory, Bourdieu's project maps out a pathway for how reality becomes constructed through the entwinements of Structure, Culture, and Agency. These entwinements fabricate the matrix of reality and life for the Habitus. For Bourdieu, the Habitus represents the self and the embattlement of the human condition. Ultimately, Bourdieu theorizes that reality is (re)-produced through the gaze of that which is tangible. However, in this project, I will liken Bourdieu's theory of reality to a camera obscura by flipping him on his head. I argue that reality is actually intangible; and once the construct has been defined and identified, reality itself becomes an illusion and mirror of the mind. Thus, I propose a theory on how one can create the reality which one prefers. From here, I reflect on the proverb "Kill Your Heroes" by figuratively killing my hero, Pierre Bourdieu. In this way, I, like the fictional superhero Wonder Woman, have no heroes. This is because heroes disembody the self from rekindling with one's inner radiance. Looking now, I conceptualize a theory of Liminality, by deconditioning the human condition, through the practices and ways of externalizing personal power.

Mentor: Dr. PS Polanah (Africana Studies, Virginia Tech)

EMMA A. HULTIN
VIRGINIA TECH / BIOLOGY

Phenology and interactions in the reproduction of Bluehead Chub (Nocomis leptocephalus) and Central Stoneroller (Campostoma anomalum) and their nest associates

Toms Creek, in Blacksburg, VA, is home to a hardworking fish called the bluehead chub. Each spawning season the bluehead chub males build large gravel mounds in which they will bury their eggs. These mounds are characterized by the presence of a suite of other fish species termed "nest associates" who participate in various activities on the nests. These nest associates also congregate around the central stoneroller, a fish that digs out pits in the substrate for their spawning. The primary aim of this study is to clarify life history strategies of bluehead chub and stoneroller and their nest associate species by defining the phenology (timing) and location (nest-host choice) of spawning. Phenology was determined by 1) observing relative species abundance on nests during breeding season using several seasons of underwater video footage, and 2) genetic identification of eggs sampled from nests. Relative species abundance was overlaid with water temperature, photoperiod, rainfall, and genetic composition of eggs from the nest. Preliminary data show a correlation between nest associate egg presence and weekly degree days. Further genetic testing will be done on eggs sampled from stoneroller nests once the breeding season begins in April.

Mentor: Dr. Emmanuel Frimpong (Fish and Wildlife, Virginia Tech)

P'TRICE R. JONES
VIRGINIA TECH / PSYCHOLOGY

Examining the Relationship Between Police Labels and Police Confidence

The relationship between police and civilians has been widely researched, especially in reference to the public's trust in police. There are several factors that influence a community's confidence in the police's ability to do their job, such as police behavior, perception of corruption, or neighborhood proximity to violent crime (Aydija, 2010; Alalehto & Larsson, 2015; Zahnow et al., 2017). There is a lack of research that correlates police labels to confidence in the police. The purpose of this research is to determine if the perception of police roles as an enforcer, protector, or both, effects confidence in the police department. This research will also examine how this relationship differs between White, Black, and Hispanic populations. The results indicated a significant relationship between confidence and police roles, those with a lot of confidence in police identified police as protectors. The analysis with race and ethnicity was also significant. The White group had the most confidence in police and within this group, were more likely to perceive the police as protectors. Within the Black group, the respondents were more likely to have some to a little confidence in the police and perceived the police as protectors. Within the Hispanic group, respondents were also more likely to have some to a little confidence in police and perceived police as enforcers. This research would aid in finding effective interventions that would improve police and citizen interactions.

Mentor: Donna Sedgwick (Sociology, Virginia Tech)

MARIAMA D. KABORE
VIRGINIA TECH / MICROBIOLOGY

Investigation of MotF interaction with MotA of the Sinorhizobium meliloti flagellar motor

Sinorhizobium meliloti is a flagellated soil bacterium that forms a symbiotic association with an agriculturally important plant, Alfalfa. Motility of S. meliloti plays a critical role in initiation of this symbiosis. Unlike other well characterized flagellar motors, which change direction of rotation during tumbling events, those of S. meliloti are speed-variable and rotate strictly clockwise. Furthermore, in addition to MotA and MotB, S. meliloti requires the novel proteins MotC, MotE, and MotF. MotF is hypothesized to interact with other Mot proteins to stabilize the motor, but experimental proof is lacking. Western blot analyses will be performed to investigate interactions between MotF and other Mot proteins. However, anti-MotA antibodies have not been generated. These will be acquired by isolating and purifying both cytoplasmic regions of the four-transmembrane protein to yield soluble peptides. The cytoplasmic regions of MotA will be overexpressed in Escherichia coli and purified using affinity chromatography purification. The isolated MotA peptides will then serve as antigens for rabbit immunization to yield anti-MotA antibody serum. The latter will enable comparison of MotA levels in a motF deletion mutant to that of wild type. Additionally, direct interaction between MotA and MotF will be investigated using anti-MotA serum in far western blot analyses. Results of these experiments will provide insight into the function of MotF in the S. meliloti flagellar motor.

Mentors: Dr. Birgit Scharf and Dr. Birgit Scharf (Microbiology, Virginia Tech), Richard Sobe (Molecular Biology Graduate Student, Virginia Tech)

NINA S. KAPPEL
VIRGINIA TECH / WILDLIFE CONSERVATION

Examining Predator Avoidance Behaviors in White-tailed Deer in Northern Florida

Predation risk can influence maternal investment when prey use antipredator behavioral strategies that reduce foraging efficiency and cause a nutritional deficient in the mother. Prey often increase vigilance in risky conditions and modify diel activities to reduce exposure. We examined the effect of predation risk on female white-tailed deer (Odocoileus virginianus) behavior. Deer occupy a unique role as a valuable resource that provides funding for wildlife management, drive plant communities in eastern forests, and significantly damage private property; thus there is interest in factors that influence deer populations. Recognizing the effects of these behavioral interactions between predators and prey is required to understand how predators affect deer in the southeastern US. Using data collected from 70 camera traps at Camp Blanding Joint Training Center in northern Florida, we investigated the effects of habitat features, soil productivity, predator activity, and reproductive condition on foraging behavior using generalized linear mixed models. To evaluate if reproductive condition induces does to modify diel activity, we compared the temporal activity of does where fawns were detected and undetected to that of predators. We found that soil productivity was a positive predictor of foraging, while coyote presence reduced foraging probability. Additionally, we found that does exhibit significantly less temporal overlap with coyotes in the presence of a fawn.

Mentor: Dr. Michael J Cherry (Fish and Wildlife Conservation, Virginia Tech)

BRIDGET KASTELBERG
VIRGINIA TECH / SYSTEMS BIOLOGY

Global Characterization of Immune Responses by Dendritic Cells in Response to A. fumigatus Viable Conidia

Aspergillus fumigatus is an opportunistic fungal pathogen of the human respiratory system. Invasive fungal growth occurs in individuals with compromised immune systems, including those undergoing neutropenia, leukopenia, and steroid treatment. Healthy immune responses include robust reactive oxygen species production, deployment of DNA-based extracellular traps, neutrophil recruitment/activation, and Th1/Th17 mediated responses. These functions are ablated in immunodeficient individuals, leading to rapid progression of infection and mortality. Our systems biology approach identified a subset of dendritic cells to be critical for the defense response towards A. fumigatus. We conducted a time course study using bone marrow derived dendritic cells (BMDCs) challenged with A. fumigatus viable conidia. Post challenge, BMDCs were harvested at 0, 3, 6, 9, and 12 hours. Purified total RNA was depleted of ribosomal RNA and used as a template to produce cDNA libraries. These libraries were then sequenced via Illumina based technology generating 15 Million single reads per sample replicate. The 15 replicates were filtered, aligned, and quantified using the mouse reference genome and the HiSAT2/Stringtie pipeline. Normalized counts per gene and differential gene expressions between time points was conducted through DESeq2. Analysis of genes encoding inflammatory proteins suggests the activation of specific immune signaling pathways known to aid in the clearance of A. fumigatus.

Mentor: Shiv Kale (Biocomplexity Institute, Virginia Tech)

JULIA A. KAWAS
VIRGINIA TECH / PHYSICS

Modeling the pathogenesis of human adenoviral myocarditis in induced pluripotent stem cell-derived cardiomyocytes

Myocarditis accounts for 42% of sudden cardiac death in young adults and involves remodeling of intercellular junctions and cardiac ion channels leading to fatal arrhythmias. Cardiac intercellular junctions encompass connexin43 gap junctions intimately associated with ion channels that together facilitate action potential propagation throughout the myocardium. Alterations in gap junction structure affects sodium channel localization and is reported in almost all forms of heart disease. Adenovirus is a leading cause of myocarditis but the impact of infection on cardiomyocyte architecture, connexin43, and sodium channel function, is essentially unexplored with species specificity hindering development of an animal model. Human induced-pluripotent stem cell (iPSC) technology provides a source of human cardiomyocyte-like cells in which to faithfully model human viral infection. Gap junctions also propagate the cell-intrinsic innate antiviral immune response and so we hypothesized that adenovirus targets connexin43 expression and function to facilitate viral replication leading to arrhythmogenic intercellular junction remodeling in the heart. Using iPSC-derived cardiomyocytes as a model we performed fixed-cell confocal microscopy, live-cell calcium flux imaging, and western blotting over a 72 hour time course following adenoviral infection. Data indicate suppression of connexin43 expression in infected cells, with significant remodeling of ion channel localization and expression.

Mentors: James W Smyth and Patrick J Calhoun (Biology, Virginia Tech)

GRANT E. KAWECKI
VIRGINIA TECH / BIOCHEMISTRY
NICK A. CRAMER
VIRGINIA TECH / BIOCHEMISTRY

Insight into Amyloid Interactions: Molecular Dynamics Simulations of Model Peptide Fragments

Amyloid-beta (A_) and islet amyloid polypeptide (IAPP) are small peptides, classified as amyloids, that have the potential to self-assemble and form cytotoxic species, such as small soluble oligomers and large insoluble fibrils. The formation of A_ aggregates facilitates the progression of Alzheimer's disease (AD), while IAPP aggregates induce pancreatic _-cell apoptosis, leading to exacerbation of type 2 diabetes (T2D). Cross-amyloid interactions between A_ and IAPP have been described both in vivo and in vitro, implying the role of A_ or IAPP as modulators of cytotoxic self-aggregation of each species, and suggesting that A_-IAPP interactions are a potential molecular link between AD and T2D. Using molecular dynamics simulations, "hot spot" regions of the two peptides were studied to understand the formation of hexamers in a heterogenous and homogenous peptide-containing environment. Systems of only A_(16-22) peptides formed antiparallel, _-barrel-like structures, while systems of only IAPP(20-29) peptides formed stacked, parallel beta sheets and had relatively unstable aggregation structures after 2 _s of simulation time. Systems containing both A_ and IAPP (1:1 ratio) hexamers showed antiparallel, _-barrel-like structures, with an interdigitated arrangement of A_(16-22) and IAPP(20-29). Eccentricity based oligomer shapes for the heterogeneous systems were very similar to those of the homogenous A_(16-22) systems after RMSD convergence.

Mentors: Anne Brown (University Libraries, Virginia Tech), David Bevan (Biochemistry, Virginia Tech)

RACHEL J. KELLIHER
VIRGINIA TECH / HNFE

hOMe: Why people practice at a community-based yoga studio

Yoga is a is a mind-body practice that is quickly gaining popularity in the United States as a mind-body practice and a fitness trend. To date, there is limited research on the motivating factors that underly why individuals regularly practice yoga at a yoga studio instead of at home or at a gym. The aim of this four-week community-based study, was to determine the various factors that motivated individuals living in rural Southwestern Virginia to regularly practice at a yoga studio that partnered with researchers. Thirty-one 31 people were invited to provide a qualitative video testimonial during a community event. 18 (58%) people agreed to provide a testimonial and were asked: "Why do you practice at [participating yoga studio]." The eighteen testimonials were transcribed verbatim and analyzed for meaning units, which were clustered into themes. Major emergent themes in this study included the mental (n=9), physical (n=9), and health (n=9) benefits of yoga in addition to the sense of community (n=13) at the yoga studio. Minor themes were a love for the instructors employed at the studio(n=4), as well as the opportunities offered at the studio for mindfulness (n=4). The data suggests that there are several variables that bring people to practice at the participating yoga studio, including being part of a community, the holistic benefits of yoga, and their overall health.

Mentor: Samantha Harden (HNFE- PARCI lab, Virginia Tech)

MATTHEW J. KILE
VIRGINIA TECH / MECHANICAL ENGINEERING

Programs for Mechanical Behavior Analysis for Intelligent Design of Architected Materials

The toe-in region of a stress strain curve is the region right before the elastic region where the slope is rapidly changing because of the materials microstructure and must not be considered when finding the modulus of elasticity of the data. Using python a program was developed to remove the toe-in region of approximately 600 data sets for various 3D printing materials printed using different structures, face centered cubic, simple cubic, and body centered cubic. The program works by calculating a line of best fit for every set of 5 data points, to help minimize errors in data collection, and compares all of these slope values to the average. All initial slope values that do not fall within five percent of the average slope value are removed from the data set to be passed to the modulus of elasticity calculations. With the toe-in region removed the modulus of elasticity value can be found by using a line of best fit for the data up until the proportional limit. Finally with the calculated modulus of elasticity values a machine learning algorithm can be trained more quickly and more accurately to output a stress strain curve based on imported material properties.

Mentor: Xiaoyu Rayne Zheng (Mechanical Engineering, Virginia Tech)

JIWOO KIM
VIRGINIA TECH / BIOCHEMISTRY

Receptor stability in Sinorhizhobium meliloti altering putative proteolysis sites

Sinorhizobium meliloti is a nitrogen-fixing soil bacterium that has a symbiotic relationship with alfalfa, a plant grown as a cover crop and animal feed. S. meliloti uses chemoreceptor proteins to detect plant chemical signals and to navigate its environment towards the plant. In the study of S. meliloti chemoreceptor stoichiometry, it was observed that the abundance of McpU increases when epitope tags (between 1 and 2.8 kDa in weight) are added to the C-terminal end. The goal of this project is to find the mechanism that increases McpU abundance. It has been found in C. crescentus that McpA abundance stays constant when the protease recognition site is deleted. Although it is not as physically apparent as in C. crescentus, S. meliloti does go through cell cycle metabolic processes such as chemoreceptor proteolysis. It is hypothesized that the addition of a tag that is several amino acids of length is physically blocking the protease recognition site. This study is important for all projects that study alphaproteobacteria's protein stoichiometry because using epitope tags for detection and quantification could be a potential pitfall. Immunoblots showing relative abundance of McpU in mutant strains are presented. The addition of single amino acid residues to the C-terminus of McpU does not influence the abundance, nor does deletion of one putative protease recognition site. Work towards investigating other sites is also presented.

Mentor: Birgit Scharf (Biological Sciences, Virginia Tech)

REBEKAH KLEWICKI
VIRGINIA TECH / HUMAN NUTRITION, FOODS, AND EXERCISE
EMILY JONES
VIRGINIA TECH / HUMAN NUTRITION, FOODS, AND EXERCISE
KILEY MARTIN
VIRGINIA TECH / BIOLOGICAL SCIENCES
RILEY MEYERS
VIRGINIA TECH / BIOLOGY

The Collaborative Process of Creating a 2-D Model of the Pituitary Gland

The purpose of this project was to work collaboratively with a team of students from the Da Vinci and Curie Living Learning Community (LLC) to accomplish a common goal and solve problems as a team. The LLC provided resources necessary to complete the project, as well as project coordinators and mentors to supervise the process. The goal of this project was to create a scientifically accurate, two-dimensional anatomical model of the pituitary gland using two sets of three acrylic panels held together by screws. One set of panels displays the flow of blood and hormones through the pituitary gland, while the other set displays the anatomy and function of the gland. To produce this model, members of the team were trained in the necessary technical skills, including laser cutting and CAD modeling. In addition, a game plan detailing weekly meetings was established. During these meetings, hand-drawn sketches were created and scanned into a 3D modeling software. This software allowed adjustments to be made so that the drawing could then be laser cut into the acrylic panels. The final outcome of this process was two sets of color-coded acrylic panels detailing the anatomy and physiology of the pituitary gland. Additionally, each member of the group gained experiences in collaborative teamwork and problem-solving throughout the process. These skills will assist students in their future work, in ways that are applicable to any profession.

Mentor: Lori Blanc (Biological Sciences, Curie and Da Vinci LLC, Virginia Tech)

SYDNEY S. KULOK
VIRGINIA TECH / PSYCHOLOGY

An Analysis of Social Competence in Individuals with Autism Spectrum Disorder and Co-occurring Conduct Problems

Objectives: In the current study, we compared social competence in individuals with ASD both with (ASD+CP) and without (ASD-CP) co-occurring CP. It was hypothesized that individuals with ASD+CP would have greater social deficits than individuals with ASD only. Methods: Participants include 31 children and adolescents with ASD (with language impairment = 4, with intellectual impairment = 6; male = 25, female = 6) between the ages of 6 and 18 years from the southwest Virginia area. Families seeking an ASD assessment visited the university clinic and research center for a diagnostic evaluation and were asked to complete several measures. The Social Responsiveness Scale - 2nd Edition (SRS-2) measures overall ASD symptomology, as well as Social Awareness (SA), Social Cognition (SC), Social Motivation (SM) and Social Communication (SCM). Co-occurring CP was determined by scores above the clinical cutoff on the Conduct Problems subscale of the Child Behavior Checklist. An independent samples t-tests were used to compare ASD+CP (n=13) with ASD-CP (n=14) on parent reports of SA, SC, SM, SCM, and total ASD severity. Conclusions: These findings help to better understand the impact that co-occurring CP can have on core ASD symptomology (i.e., social competence), such that individuals with co-occurring CP had more severe impairments with regard to social motivation, cognition, and awareness.

Mentor: Angela Scarpa (Virginia Tech Center for Autism Research, Virginia Tech)

ERIN LE
VIRGINIA TECH / HNFE

Understanding the Molecular Regulation of NHLH2 in Prader-Willi Syndrome

Prader-Willi Syndrome (PWS) is a complex genetic disorder that causes life-threatening obesity in children. Characteristics of PWS include insatiable hunger, weak muscles (hypotonia) at birth, intellectual disability, small hands and feet, and an inability to produce reproductive hormones (hypogonadism). PWS is caused by the deletion of the paternally-expressed chromosome region between 15q11-q13, with the smallest common deleted region containing the non-coding RNA SNORD116. This type of non-coding RNA works by interacting with other RNAs to regulate their expression, translation, or splicing. Our laboratory is trying to decipher how deletion of SNORD116 contributes to PWS phenotypes. Previous work has shown that human stem cells from PWS patients express significantly less nescient-helix-loop-helix-2 (NHLH2) mRNA and protein compared to stem cells from normal controls. Deletion of Nhlh2 in mice recapitulates many of the phenotypes seen in PWS, making it a good candidate target for SNORD116 action. We are using mouse neuronal cell lines to investigate how Snord116 levels may regulate Nhlh2 levels. To do this, multiple plasmids had to be created. In this project, using the techniques of molecular cloning, we were successful in generating a control plasmid which can now be used to observe the downstream effects of plasmid cDNA5/FRT/TO without the SNORD116 insert in mouse neuronal cells.

Mentors: Deborah Good (Human Nutrition, Foods, and Exercise, Virginia Tech), Matthew Kocher (Human Nutrition, Foods, and Exercise Graduate Student, Virginia Tech)

TWYLA T. LEE
VIRGINIA TECH / BIOCHEMISTRY

The Role of Kir4.1 in the Development of Epilepsy

Temporal lobe epilepsy is the most common form of epilepsy accounting for 60% of epileptic cases. The issue remains that 1 in 3 patients do not respond to anti-epileptic drugs (AEDs) that most target treating neuron hyperexcitability. Most studies focus on neuronal contribution to epileptogenesis, but our study focuses on the role of astrocytes in this complex process. Astrocytes have a multitude of functions, including regulating neuronal hyperexcitability by mediating spatial potassium buffering after an action potential, primarily done through Kir4.1 potassium channels. Few have studied Kir4.1 in post-traumatic epileptogenesis, but severe epileptic symptoms occur when Kir4.1 is knocked out in mice suggesting that dysfunction of Kir4.1 channels can lead to epileptogenesis by disrupting spatial potassium buffering This study used Lithium pilocarpine-induced status epilepticus (SE) to induce epilepsy, which is advantageous to provide the animals with a latency period of 30 days after SE before experiencing spontaneous seizures that mark the onset of epilepsy. The latency period is the prime time to analyze spatiotemporal changes in Kir4.1 and GFAP levels in rat hippocampus during epileptogenesis isolated at 1,7, and 30 days. Western blotting and qPCR were used to quantify the protein and mRNA expression. We found that Kir4.1 mRNA and protein expression was significantly decreased as early as 1 day post SE until 30 days suggesting that Kir4.1 plays role in epileptogenesis.

Mentors: Michelle Olsen and Jessica Boni (Neuroscience, Virginia Tech)

SOPHIA R. LINK
BLACKSBURG HIGH SCHOOL / BLACKSBURG HIGH SCHOOL SENIOR

The Role of the IPK1 and ITPK1 Genes in Plant Sucrose Sensing

Inositol phosphates are important plant signaling molecules whose role in nutrient sensing pathways could help lead to advancements in crop and environmental sciences. This study sought to determine the role of the inositol phosphate InsP6 in the sucrose sensing pathway of Arabidopsis thaliana. To do this, loss of function mutants of the IPK1 and ITPK1 genes, plants that overexpress the IPK1 gene, and wild type plants were grown on no sucrose and 3% sucrose plates. Root length measurements were collected, and two-sample Student's t-tests were used to test for statistical significance between the altered plants and wild type plants on each plate. It was hypothesized that ipk1- and itpk1- mutants would be longer on no sucrose and shorter on 3% sucrose when compared to wild type; IPK1OE plants were expected to have an opposite response. The ipk1- plants were found to be significantly shorter on 3% sucrose plates, and the itpk1- plants were significantly shorter on both plate type. The IPK1OE plants showed no significant differences to wild type in any conditions. These results indicate a role for InsP6 in plant sucrose sensing pathways and a role for InsP4 and InsP5 in plant root growth and seed viability.

Mentor: Dr. Glenda Gillaspy (Biochemistry, Virginia Tech)

COURTNEY R. LINKOUS
VIRGINIA TECH / WILDLIFE CONSERVATION

Vegetation choice for nest-site selection of Song Sparrows among rural and urban habitats

Vegetation choice plays an important role in nest-site selection as it may determine whether a nest becomes predated or makes it to full term. The goals of this research project are to compare the plant species that are selected for nest-sites by Song Sparrow breeding pairs from rural and urban habitats and assess how the following factors affect birds' survival and success in producing offspring by observing the following: (1) Vegetation chosen for nest sites, (2) Nest height and depth within the vegetation (when possible), and (3) Rates of predation and success (number of young fledged from full term nests.) This study uses previously collected data points for nests from the 2017 and 2018 breeding seasons. Data collected from the 2018 field season was used to examine the impact of the height and depth of nest placement within the vegetation on nest success. Collectively, this information will allow the determination of how plant selection influences nest survival. This information could be used by managers and developers to create urban and suburban areas that are more hospitable to wildlife. Anticipated outcomes of this study are that nests placed in vegetation with some form of protection (such are spines or thorns) will have higher survival rates to full term, while nests in vegetation that is not protected will have higher predation or fail rates. It is also anticipated that nests placed further in the vegetation will be less likely to be predated.

Mentor: Kendra Sewall (Biology, Virginia Tech)

ZICHEN LIU
VIRGINIA TECH / LANDSCAPE ARCHITECTURE

"Shan-shui": A Framework for Urban Expansion within a Mountain and Water Landscape

China has embarked upon an ambitious urbanization that threatens vernacular agricultural landscapes, the intimate social relationships and ties between people and nature that characterize rural Chinese settlements. This project proposes an innovative strategy to accommodate urban expansion in a 2600 acre rural district on the periphery of the rapidly urbanizing city of Hangzhou. Low-lying land in this area has been farmed for centuries by controlling water inundation through a system of dikes and drainage channels that form a "polder" landscape. The proposed development framework aims to achieve a harmonious rural/urban spatial integration; to preserve and revitalize fundamental social relationships, while accepting population expansion; and to improve local economies. The research focuses on the form and function of polder landscapes and related agriculture practices; the spatial organization and social functions of traditional and contemporary rural Chinese villages; and the role of landscape in classical Chinese art. Research methods include literature review, analytical drawings, case studies, on-site field surveys, and interviews with local residents. The design proposes residential intensification and enhanced agricultural practices that respond to existing settlement and agricultural patterns in the polder landscape, and to the dual landscape elements of mountainous landform and water ("Shan-shui") presenting in rural China and in classical Chinese landscape painting.

Mentor: Wendy Jacobson (Landscape Architecture, Virginia Tech)

WENKUN LIU
VIRGINIA TECH / MECHANICAL ENGINEERING

A Natural Low-Density Structure in Cuttlebone: Structural and Mechanical Analysis

Cuttlebone is both a skeletal element and a buoyancy tank for cuttlefish. Despite its high porosity and brittle composition material (aragonite), it is known to have outstanding mechanical properties with graceful failure under compression. The cuttlebone consists of many horizontal chambers supported with arrays of vertical walls. These walls supporting each chamber's floor and roof exhibit wavy cross-sectional profiles and an intricate labyrinthic pattern, which may contribute to the cuttlebone's strength and toughness. In addition, the geometry of the wall should also allow for efficient fluid transport within cuttlebone for buoyancy adjustment for the animal. This study aims to acquire quantitative structural and mechanical analysis for the wall structure. Electron micrographs are used to capture the 2D labyrinthic pattern of the walls near the chamber floor. This unique pattern is traced manually and analyzed using ImageJ. It is found that the walls near the entrance of fluid appear more directional and less wavy compared to the walls in the interior of cuttlebone. The variations of the wall cross sections in 3D are analyzed by using synchrotron tomography measurement. Mechanical simulations were conducted on different wall sections to evaluate the effects of wall waviness on the mechanical properties of the structure and the stress distribution within the walls. It is found that a higher degree of waviness leads to higher strength.

Mentor: Ling Li (Mechanical Engineering, Virginia Tech)

ERIC D. LUU
VIRGINIA TECH / MULTIMEDIA JOURNALISM

Audience Responses to Asian-American Hate Speech in Immersive Video

The goal of this study is to find how audiences respond to 360 videos when viewing stories that show a fictional representation of a story depicting racism towards Asian-Americans. Using 360 video, the purpose of this research design is to test attitudes and feeling of immersion within and across conditions. The questionnaire is designed to test our assumption and to better understand how characteristics of users (e.g. level of motivation, feelings of realism) affect attitudes towards the story. It is hypothesized that participants who view videos with narration using virtual reality headsets will feel more immersed than those who view the 360 videos on mobile devices. We hypothesize the data will show that participants who use virtual reality headsets will feel more immersed than those who view the 360 videos on their mobile phone. We also hypothesize that interest in the issue (e.g. measured by motivation to seek out social justice stories) will influence how individuals respond to the story.

Mentor: Mike Horning (Communications, Virginia Tech)

ALEXA M. LYNN
VIRGINIA TECH / APSC

Nutritional Interventions Alter Muscle Fiber Type Expression in Neonatal Pigs

Dietary changes impact muscle growth and fiber type distribution. Altering dietary energy or protein content will not only cause changes in overall animal growth but also tissue specific alterations which can influence meat quality. It is not known how these dietary changes impact fiber type distribution in muscle. This study aimed to determine the effects of dietary energy and protein content on fiber types. Muscle tissue samples were collected from neonatal pigs fed a 17-day treatment of excess, adequate, or deficient dietary protein or energy. Expression levels of each myosin heavy chain (MHC) was determined using qPCR and isoform. Changing the energy content of the diet did not affect MHCI, MHCIIa, or MHCIIb expression. A slight decrease in MHCIIx expression ($p=0.03$) was observed in energy excess and deficient groups. Reducing dietary protein content did not affect any form of MHC expression. Animals fed a diet with excess protein displayed a reduction in MHCIIa ($p<0.01$) and MHCIIx ($p=0.03$) expression. Reductions in MHCIIa and MHCIIx coupled with an increase in MHCIIb expression indicated a preference towards a more glycolytic phenotype in excess protein fed animals. Type IIb fibers express an mTOR complex which is more sensitive to AA induced changes in transcription and translation, explaining the increased expression in MHCIIb. However, IIb fibers are associated with decreased pH and tenderness indicating a higher protein diet may be detrimental towards meat quality.

Mentor: Dr. Rob Rhoads (APSC, Virginia Tech)

SID S. MADHAVAN
VIRGINIA TECH / CLINICAL NEUROSCIENCE

Identification of Key Sequences in Human Tau Protein for Aggregation in Dementia

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

Mentors: Dr. Bin Xu and Dr. Ling Wu (Biochemistry, Virginia Tech)

EMILY MAHER
VIRGINIA TECH / MULTIMEDIA JOURNALISM
DYLAN FINCH
VIRGINIA TECH / COMPUTER SCIENCE
NICK CLARK
VIRGINIA TECH / COMPUTER SCIENCE

Picturing Trails: Application for Storyboard Creation

Nowadays, whether it be to capture their precious memories or to boast about their activities on social media, it is becoming increasingly popular for people to take photos everywhere they go. Picturing Trails will allow users to create professional photo story in ease. With Picturing Trails, anyone can create a professional photo story by simply uploading the photos to the application. The application will store the other stories that you have created as well, naturally making a magnificent, organized photo collage. Overall, this application will satisfy the users' need and desire to create a photo story during their busy lives. We gathered information on how trail blazers use their media on the trails, by forming focus groups, surveys, and observing community members. As the semester continues to unfold we hope to continue to gather more information about our potential users and application features to include in our results. As of now, we will use the information we have already gathered about hiking mobile application and hikers themselves to start building the application, while still continuing to gather and build.

Mentors: Dr.MIchael Horning (Communication, Virginia Tech), Derek Haqq (Computer Science Application, Virginia Tech)

ANKIT MALHOTRA
VIRGINIA TECH / COMPUTER ENGINEERING
AJAY KAMALAKANNAN
VIRGINIA TECH / COMPUTER ENGINEERING
YAOQUAN SONG
VIRGINIA TECH / COMPUTER ENGINEERING
GIONATHAN VILONE
VIRGINIA TECH / INDUSTRIAL AND SYSTEMS ENGINEERING
DAGGEM SAMUEL
VIRGINIA TECH / COMPUTER ENGINEERING
JOHAN MORAES
VIRGINIA TECH / MECHANICAL ENGINEERING
SANG NGUYEN
VIRGINIA TECH / COMPUTER SCIENCE
SREEVATHSA GIRIDHAR
VIRGINIA TECH / COMPUTER ENGINEERING

TechSmith

The goal of our group, TechSmith, is to create a delivery robot called RC-APEX. The point of having the delivery robot is to have a helping hand in delivering food to any place on campus. If someone orders a meal anywhere on campus (ground level), this delivery robot should be able to navigate through and arrive at the destination without spilling over any beverages or food. We created our own deadlines to help keep us on track. The RC car serves as a base for this robot. We are using Arduino to program the sensors and other devices on/in the RC car. We also have a frame that will keep all electronics, food, and other items in place. We anticipate to have this robot delivering orders to costumers on campus, properly.

Mentor: N/A

TUSHAR MALIK
VIRGINIA TECH / ECONOMIC

The Cycle of Surveillance

We will explore the thematic of surveillance as a cause as well as an effect of social and political problems. The overarching methodological objective of the research is to subject surveillance practices to a form of immanent critique: to problematize present surveillance realities with the intention of envisioning a different kind of future. In doing so, I do not engage in a "politics of dreaming" about a future society that would be free of all forms of surveillance. We are keenly aware that surveillance is a central component of modern statehood. Running through the reseach, however, is a normative critique that calls into question the moral and ideological bases, as well as the differential material effects, of various surveillance practices and systems. The rest of the research is organized into four parts. In Part 1 ("Stigma, Morality, and Social Control") is to explain some of the historical dimensions of surveillance as a social and political problem. In Part 2 ("Environmental Design, Consumerism, and Privacy"), we present parts that engage the themes of visibility and privacy in substantively unique ways. In Part 3 ("Genetics, Security, and Biometrics") is to examine the complex, troubled, and contradictory relationship between surveillance and security. In Part 4 ("Participatory Surveillance and Resistance"), we present parts that explore how groups of people in different social locations participate in, and resist, surveillance regimes.

Mentor: Peter Schmitthenner (Religion and Culture, Virginia Tech)

PATRICK MANIJAYME
VIRGINIA TECH / LANDSCAPE ARCHITECTURE

Float like a Butterfly, Think like a Bee: An oasis for pollinators and people

Incorporating the understanding of native pollinator behavior and habitats to provide an environment that fits within a greater ecological system to conserve native species. This project will design an oasis for pollinators by using a neighborhood park as the landscape to rebuild and restructure harmony while developing management and design strategies to explore social, education, and environmental values. This landscape will fit into the movement of conserving and protecting pollinator species while maintaining itself as a neighborhood park that bridges the relationship between the natural and urban ecology. Threading the role of pollinators in the environment into the fabric of neighborhood park design were the inner workings of the project that drove it forward. This ultimately created a park that provides opportunities for habitats of bees, hummingbirds, butterflies, while maintaining an educational collaborative neighborhood park.

Mentor: Terry Clements (Landscape Architecture, Virginia Tech)

JESSICA E. MARINO
VIRGINIA TECH / HNFE

Is there a correlation between the Monoamine Oxidase A gene and the motivation to exercise in student volunteers from Virginia Tech?

With new research, there have been links to human aggression with the Monoamine Oxidase A (MAOA) gene. This gene degrades amines, like dopamine, and when found at decreased levels, in humans, one is said to have the Warrior Gene. People with the Warrior Gene have tendencies for higher aggressive-like behaviors. During exercise, humans release dopamine, which can have pleasure-like side effects, and in return create a positive reinforcement with physical activity. If one's dopamine levels are genetically higher, due to a lower activity of the MAOA gene, there could be a greater motivation to exercise, for that person. Current assumptions suggest that the variable number of tandem repeats (VNTR) for the single-nucleotide polymorphism (SNP) rs909525, determine if the Warrior Gene is present. By using saliva samples, from Virginia Tech volunteers, the genomic DNA was isolated and purified. Volunteers completed 23AndMeâ„¢ ancestry DNA kits, and using the raw DNA data, PCR-based genotype as well as in silico analysis will be analyzed to determine the VNTR for the rs909525 of the subjects. A survey was taken to see each subject's motivation to exercise on a self-determined scale. These responses will then be matched with the analyzed DNA to determine if the VNTR for the SNP has a correlation to the subject's motivation to exercise. Overall, this project will test the hypothesis of whether a lower number of tandem repeats (3 repeats), will correlate with higher motivation to exercise.

Mentors: Deborah J. Good and Angela S. Anderson (Human Nutrition, Foods, and Exercise, Virginia Tech)

WILLIAM W. MARTIN
VIRGINIA TECH / ENVIRONMENTAL RESOURCE MANAGEMENT

Invasive species introduction and the effects on native host-symbiont relationships

The experiment seeks to understand how the introduction of an invasive species affects the native host-symbiont relationship by examining species of the superfamily Astacoidea (crayfish). Native crayfish, among others, engage in symbiotic relationships with organisms from the order: Branchiobdellida. This experiment explains how the introduction of invasive crayfish species (Orconectes virilis) affect the movement of symbionts in native host-symbiont systems of Cambarus appalachiensis. This will give insight into how other invasive species introductions could not only directly affect native species through increased competition but also indirectly when concerning symbiotic relationships. The expected result is that the five enclosures that contain both the native and invasive species will have native species with a significantly altered composition of symbionts when compared to the treatments of only one species. This result was not supported by statistically significant data analysis. However, the results of the experiment could help to understand the overall impact that introductions of invasive species may have on aquatic communities by demonstrating that introduction could affect these symbiotic relationships. This experiment may also be useful for the scientific community to speculate about how symbiotic relationships of other species could be affected by the introduction of invasive species and the resulting impact on their respective communities.

Mentors: Dr. Bryan L. Brown (Biological Sciences, Virginia Tech), Sara Cathey (Biological Sciences Ph.D Student, Virginia Tech)

CAITLIN M. MCCAUGHAN
VIRGINIA TECH / BIOLOGICAL SCIENCES

Tetrodotoxin Resistance of Nav 1.8 in Snakes that Consume Toxic Newts

Tetrodotoxin resistance in garter snakes that eat toxic rough-skinned newts provides an example of a coevolutionary arms race. Newts use tetrodotoxin as defense against snakes, which causes selection on snakes to become resistant to higher levels of tetrodotoxin. The resistance mechanism of snakes involves voltage-gated sodium channels, making tetrodotoxin unable to bind and subsequently block the flow of the channel. Nine such channels have been identified, and the focus of this research is on Nav 1.8, located in pain-sensing neurons. Previous research showed tetrodotoxin resistance in Nav 1.8 evolved about 18 million years ago. The phylogenetic tree is not complete, due to the inability to sequence DNA from the subfamily Dipsadinae. The project focuses on designing primers to amplify Nav 1.8 to complete the tree. We utilized standard PCR and Sanger sequencing to confirm alignments, followed by Geneious assembly and analysis for tetrodotoxin resistance. If the dipsadines are found to be nonresistant, this will confirm that Nav 1.8 evolved 18 million years ago, after encountering the New World toxic newts. If resistance were found in dipsadines, the evolution of Nav 1.8 would have been about 20 million years earlier, and occurred alongside tetrodotoxic newts.

Mentors: Joel McGlothlin and Angela Hornsby (Biological Sciences, Virginia Tech)

LINDSEY E. MCCLAIN
VIRGINIA TECH / HUMAN NUTRITION, FOODS, AND EXERCISE

Genotype and Phenotype Analysis of MTHFR Polymorphisms in Virginia Tech Students

The human Methylenetetrahydrofolate Reductase (MTHFR) gene is located on chromosome 1, position 36.22 (1p36.3). This gene's primary function is to produce the MTHFR enzyme which is responsible for the folate (vitamin B9) cycle. MTHFR enzyme sits at the junction between folate metabolism and the homocysteine-methionine cycle. A disruption in either of these cycles could lead to high homocysteine serum levels, which is associated with neurological disorders such as autism spectrum disorder and major depressive disorder. The C677T (rs1801133) single nucleotide polymorphism (SNP) has the greatest known effect on MTHFR activity. An individual with a heterozygous variant (677 C/T) will experience a ~35% reduction in MTHFR enzymatic activity, while an individual with a homozygous variant (677 T/T) will experience an 80-90% reduction in MTHFR activity. DNA was extracted using saliva samples from a cohort of Virginia Tech students. Currently, these samples are undergoing genotyping and will be compared to saliva donor's responses to a questionnaire relating to their personal and familial connections to these disorders as well their dietary experiences. Individuals with a variant on this SNP may experience negative physical or emotional effects after eating foods with high homocysteine levels such as meat, dairy, and alcohol. Ultimately, the frequency of these phenotypes associated with the MTHFR variant in this cohort of students will be determined, and dietary recommendations made.

Mentors: Deborah Good and Angela Anderson (Human Nutrition, Foods, and Exercise, Virginia Tech)

SCOTT T. MCGUIGAN
VIRGINIA TECH / CHEMISTRY

Electrochromic Tungsten Oxide Thin Films for Dynamic Glass Utilizing Intercalating Chemistry

This research involves developing a thin electrochromic tungsten oxide film using a spray deposition technique for dynamic glass applications. In using a less expensive approach than some magnetron sputtering methods and a more practical approach than spin-coating processes for large scale operations, the goal of this study is to create a cathodic oxide rivalling the efficiency of currently used films. Dynamic glass has been explored as an energy saving application by monitoring solar light transmittance and heat absorption to reduce electricity costs associated with indoor comfort. Electricity demand is not only costly but environmentally damaging when current non-renewable energy is the source. Analytical methods are used to characterize the tungsten oxide thin film's thickness, porosity, and performance. These methods include scanning electron microscopy (SEM), profilometry, cyclic voltammetry (CV), and UV-Vis spectroscopy. It is critically important to measure how the electrochromic material performs over many cycles between the bleached and colored states at different electrochemical parameters to deductively find optimal operating conditions. This study will lead to a better understanding of how the size and composition of the electrochromic film effects the efficiency of the ion intercalation to minimize the switching speed and limit the degradation that occurs during cycling.

Mentors: Feng Lin and Anyang Hu (Chemistry, Virginia Tech)

KELSEY MCMAHON
VIRGINIA TECH / SOCIOLOGY

Effects of Adult Prisons on Juvenile Delinquents

This research project intends to more fully understand how juvenile delinquents are affected when they are placed in an adult prison system. This research should provide the basis to begin a dialogue about what juveniles face in a system not built for them and perhaps spark efforts to change that aspect of our criminal justice system. In order to gather data on this issue, the researcher reviewed literature of previous studies focusing on juveniles in prison, reviewed the current juvenile imprisonment legislation and how it differs between states, and interviewed people involved closely with the juvenile justice system itself. What resulted from these literature reviews and interviews was the consensus that the adult prison system is detrimental to the health and well-being of juveniles. It was also found to put youths at a greater risk to commit more crimes in the future. Through this analysis, significant evidence was found that the criminal justice system must be altered in a manner that allows juveniles a chance to better themselves through a system made for them, such as a youth detention center, as opposed to placing them in a facility made for adults.

Mentor: Dr. Shoemaker (Criminology, Virginia Tech)

ELIESER A. MEJIA
VIRGINIA TECH / ELECTRICAL ENGINEERING

Fabrication of Transparent Nanohole Array Templates for Multi-layer Thin Film Deposition

Advancements in nanotechnology depend on fabrication methods capable of producing high resolution structures with precise control. Other factors such as reproducibility, throughput, range of applications, cost, and scalability play a major role in determining the practicality of a particular method. Over the years, nanoimprint lithography has proven to be a cost-effective and reliable method capable of yielding high resolution nanostructures with the promising potential of mass fabrication for commercial applications. With this in mind, the primary goal of this project is to develop a low-cost, high throughput, and scalable nanoimprint patterning process to fabricate nanohole array templates that can be used for thin-film deposition, producing nanoantennas consisting of Au and SiO2 on a glass substrate. Overall, the fabrication method of the template involves the use of polymers with select thermal, chemical, and mechanical properties to produce both the mold used for imprinting and the bi-layer polymer stack which serves as the template base. A desktop nanoimprint lithography tool was used to imprint an array of holes in the polymer stack to create a template for physical vapor deposition. Characterization tools such as atomic force microscopy was used to evaluate the quality of the template. The fabrication process successfully yields uniform nanoarray templates, and the next phase in the project is to incorporate a method to tailor the geometry of the holes.

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

ALLEN W. MILBY
VIRGINIA TECH / WILDLIFE CONSERVATION

How disturbance history affects lichen and bryophyte diversity in two on-campus old growth forests

Old-growth forests are unique habitats often characterized or identified by their lichen and bryophyte diversity. Although these taxa are used as indicators of old-growth conditions, little is known of the impact disturbance has on their diversity. We compared and contrasted cryptogam diversity in two old-growth forest tracts on the Virginia Tech campus in Blacksburg, Virginia, to quantify disturbance impacts. Stadium Woods is located on the main campus directly adjacent to the football stadium, where it has experienced significant amounts of use from football patrons, forestry students, the corps of cadets, and after World War II, was the home a housing area for veterans. Another stand, Center Woods, is offset from the main campus and has been mostly used by the wildlife department for various research projects over the years, experiencing much less disturbance than Stadium Woods. Both tracts are dominated by oaks and northern hardwood species such as Quercus alba, Quercus rubra, Acer rubrum, and Prunus serotina. These tracts are remnants of the same original contiguous forest that once covered the Blacksburg area prior to European colonization. Stadium Woods and Center Woods provide an opportunity to compare how the history of disturbance in these forests has affected lichen and bryophyte diversity. We used PerMANOVA and a two-step cluster analysis to quantify disturbance effects on cryptogam abundance in these two old-growth forest tracts.

Mentor: Dr. Jordan Metzgar (Biological Sciences, Virginia Tech)

CAITLIN A. MILLER
VIRGINIA TECH / WILDLIFE CONSERVATION

Dissolved organic carbon uptake by microbes in a stream confluence mixing zone

Streams are a continuous flow of water, transporting nutrients such as dissolved organic carbon (DOC) downstream. They eventually connect with other streams to form a confluence where water and transported materials mix. There has been limited research conducted on stream confluences despite their ubiquity in stream networks. The purpose of this research was to quantify differences in microbial uptake of DOC in the mixing zone of Stroubles Creek and Walls Branch confluence. We conducted laboratory incubations of streamwater to compare DOC uptake rates as Stroubles Creek and Walls Branch mixed downstream of their confluence. We took samples 25m, 75m, and 125m downstream of their confluence, with the water at 125m being fully mixed. We hypothesized that uptake would be additive: samples from within different points in the confluence mixing zone would have uptake rates proportional to volumetric contributions from Stroubles Creek and Walls Branch, as estimated from their distinct conductivity signatures. The uptake of DOC in Stroubles Creek in November was 0.074 1/day, which is higher than Walls Branch's rate of 0.066 1/day. The difference between the mean uptake rate at 25m and the mean uptake rate at 75m is 0.058 1/day. Within the 25m transect, the difference between any of the three points is a maximum of 0.050 1/day. In the 75m transect, the maximum difference is 0.072 1/day. Ongoing research is exploring the persistence of enhanced DOC uptake at confluence across seasons.

Mentors: Erin Hotchkiss (Biological Sciences, Virginia Tech), Stephen Plont (Biological Sciences Graduate Student, Virginia Tech)

JONATHON M. MONROE
VIRGINIA TECH / BIOLOGICAL SCIENCES

The effects of spatial and temporal hydrologic variation on microbial carbon-substrate metabolic diversity

Global climate change increases variability in weather and resulting surface water connectivity among ecosystems. These variations cause rapidly changing interactions within ecosystems that result in microbially-enhanced greenhouse gas emissions. The role of microbes in carbon cycle responses to changing climate and hydrology is still poorly quantified. To better predict the effects of climate change, changing microbial metabolic diversity over space and time must be linked with environmental changes. Microbial functional diversity was analyzed through a community-level physiological profiling method using Biolog EcoPlates, which contain 31 different carbon substrates in triplicate per plate. Surface water and benthic samples from six sites along a tributary stream of Poverty Creek were added to individual EcoPlates and absorbance measurements were analyzed for changes in color that directly relate to the rate of metabolism. Significant differences in microbial metabolic diversity and metabolic rates are present among spatially isolated sample sites including intermittent discontinuities and persistent surface water flows. Sampling is ongoing to determine how temporal differences in metabolic diversity are occurring due to varying flow levels and seasonal changes. By measuring changes in the functional diversity of microbial carbon metabolism, the data will inform further consequences of environmental changes on carbon cycling and freshwater ecosystem function.

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

AUDREY C. MORRIS
VIRGINIA TECH / AGRICULTURE SCIENCE
ALEXIS M. SMITH
VIRGINIA TECH / AGRICULTURE SCIENCE

Virginia Cooperative Extension Internship: Best Practices

The goals of this project was to learn more about the VCE intern's personal experiences in their Extension internships, consider how Extension internships serve as a form of experiential learning, consider how Extension internships might be improved. The purpose of this project was to take the feedback gained from the interns and apply it to making improvements on the internship program. The feedback gained was achieved through Qualtrics Survey. The survey had well thought out research questions that focused on the interns experiences throughout the internship. To gain more knowledge about challenges the interns faced, how the internship is influencing their future career, and opportunities interns received during internship, we are having interns and their supervising agents participate in focus groups. These focus groups are conducted through online video application. We hope to gain more personal, and well thought-out responses through the focus group. The findings suggest that the internship is a positive and educational experience for the interns. Some recommendations for change included changing the time frame of the internship, providing more orientation for the intern, and utilizing the internship handbook more throughout the internship. After gathering the findings, we had the opportunity to present the information to agents from all around the state to prepare them for the upcoming summer 2019 interns.

Mentor: Karen Vines (Agriculture, Leadership, and Community Education, Virginia Tech)

CLAIRE M. MORTON
BLACKSBURG HIGH SCHOOL / BLACKSBURG HIGH SCHOOL STUDENT

The Relationship Between Codon Usage Bias, mRNA Half-Life, and the Ste13 Protein

The half-life of messenger RNA (mRNA) is closely regulated by cells to ensure proper levels of protein production. Recent research in bacteria and budding yeast has suggested that mRNA half-life correlates with codon usage bias: mRNAs with a high frequency of "non-optimal" codons are short-lived. In budding yeast, the short half-life of such mRNAs depends on the RNA-interacting protein, Dhh1p. Whether this extends to other organisms is unknown. This research sought to address the potential role of the Ste13 protein, the fission yeast ortholog of Dhh1p, in modulating the half-life of mRNA. To this end, the ste13 gene was knocked out in Schizosaccharomyces pombe. The effect of this deletion on the expression of three genes was examined. These genes are important for the proper execution of cell division and were chosen because they have a high fraction of non-optimal codons and their protein concentrations are known to be important for function. The mRNA levels were quantified by single-molecule fluorescence in situ hybridization (smFISH). Analysis using Fiji and MatLab indicated elevated steady-state mRNA levels as compared to wild-type cells. These results are consistent with the hypothesis that the Ste13 protein in fission yeast acts as a regulator of mRNA half-life dependent on codon optimality. mRNA half-life modulation through codon usage may therefore be widespread across eukaryotes and may have an influence on protein levels and cell-to-cell variation.

Mentors: Mrs. Katharine Davis (Chemistry, Student Research, Blacksburg High School), Dr. Silke Hauf (Biological Sciences, Virginia Tech)

DOUGLAS W. MURRAY
VIRGINIA TECH / BIOLOGY

Investigating differences in pRb binding affinity between MAdV1 and MAdV3 E1A using surface plasmon resonance (SPR)

Adenoviruses are non-enveloped dsDNA viruses that cause a variety of human pathologies such as viral myocarditis. To enable replication of viral DNA genome, Adenovirus must force the host cell into S-phase. Adenovirus early region 1A (E1A) is the first region of the viral genome to be expressed during infection. The E1A proteins facilitate subsequent viral gene expression while targeting cellular cell cycle checkpoint proteins such as the retinoblastoma protein (pRb) to enable S-phase entry. Though pRb normally exerts wide control over host cell gene expression through interactions with the E2F transcription factors, E1A bound pRb is inhibited. Mouse Adenovirus 1 (MAdV1) is a common model for studying adenovirus and can be isolated from lungs, kidneys, and ganglia cells of infected mice. A recently isolated virus, Mouse Adenovirus 3 (MAdV3) was reported to have cardiotropic characteristics. The region of least conservation between MAdV1 and MAdV3 genomes is E1A, leading us to hypothesize that altered pRb interaction may influence tissue tropism. MAdV1 and MAdV3 E1A pRb binding motifs were amplified and cloned into the pGEX-6P-2 plasmid for expression and in vitro purification. Similarly, the sequence of pRb known to interact with E1A will be cloned and purified. We will then employ surface plasmon resonance (SPR), to measure the binding affinities of MAdV1 and MAdV3 E1A to pRb. This will provide insight into cell-cycle perturbation in serotype-specific adenoviral disease.

Mentor: James Smyth (Biological Sciences, Virginia Tech)

MADISON E. NARDI
VIRGINIA TECH / ANIMAL AND POULTRY SCIENCES

The Effects of Zinc Supplementation on In Vitro Bovine Embryo Development

Demand for and use of in vitro produced (IVP) embryos is growing in the fields of beef and dairy production, as this technology allows for the production of a significantly larger number of offspring from a single donor. IVP embryos, however, experience lower developmental and pregnancy retention rates than in vivo produced embryos. These problems are most likely due to insufficient culture conditions. Zinc is lacking from culture media even though it is an essential micronutrient that plays important roles in cell health and reproduction. This project works to determine the effects of zinc on development of in vitro produced embryos, with indications that adequate zinc supplementation will lead to improved embryonic development. To perform the study, follicles of ovaries were slashed to collect oocytes, and the cumulus-oocyte complexes were allowed to mature for 21 to 24 hours before they were fertilized and cultured in media that did not contain zinc. 14 to 18 hours after fertilization, the cumulus cells were stripped from the complexes, and embryos were cultured in groups of 20-30 in drops containing 0, 2, 20, and 40 µM concentrations of zinc. Cleavage rates were measured on day 3, and on day 8, assessment of blastocyst formation rates and grades were conducted. Results of the study have indicated that development rates are best at the 2 µM concentration of zinc, and replicate studies are being conducted to continue to detect differences between treatments.

Mentor: Alan Ealy (Animal and Poultry Sciences, Virginia Tech)

CHRISTINA A. NELSON
VIRGINIA TECH / WILDLIFE CONSERVATION

Incorporating Technology and Multidisciplinary Thinking into University Collections

Collaboration between museum curators and specialists in seemingly disparate fields of study has allowed for the expansion of many areas of research and the opportunity to find new uses for technologies to revolutionize the role of collections. By opening up collections to people from fields outside of the intended discipline, many opportunities for research, outreach, innovation and potential funding may arise. My project focuses on incorporating technology into collections through digitization and 3D printing of specimens. CT and surface scanning provide high-resolution 3D images of an object without damaging the specimen, opening up myriad new research and outreach applications. My experience with these technologies are being applied to the Virginia Tech fish and wildlife collection with Dr. Carola Haas and George Brooks. I am surface scanning and 3D printing specimens to supplement species lacking representation in the collection, and for use as teaching aids and loan kits for the K-12 and undergraduate classes. Additionally, scans can be uploaded to online repositories, and accessed from anywhere in the world. New technologies and the incorporation of seemingly dissimilar fields of study are beginning to reveal the true potential of museums. Millions of preserved specimens, representing centuries of collecting, are just waiting to be unlocked.

Mentors: Carola Haas and George Brooks (Fish and Wildlife Conservation, Virginia Tech), Michelle Stocker (Paleobiology, Virginia Tech), Lori Blanc (Biological Sciences, Virginia Tech)

JULIE T. NGUYEN
VIRGINIA TECH / PHYSICS

Phase transitions in DMPC/DSPC mixtures

Lipids with distinct properties have different phase transitions depending on various factors, such as length of the fatty acid chains, number of double bonds, and the resultant lateral packing. Phospholipid bilayers or membranes naturally exist in our bodies in a specific ratio of different types of lipids. The purpose of this experiment is to determine the phase transitions of membranes of length mismatched DMPC (14:0) and DSPC (18:0) lipids with different mixing ratios. We use DSC and/or density measurements as well as Langmuir compression isotherms to understand the effect of lipid mixing on fundamental bilayer properties, such as domain formation and membrane fluidity. Our measurements indicate that lipid mixing alters the phase transition temperatures and result in less efficient lipid packing within the membrane.

Mentor: Professor Rana Ashkar (Physics Department, Virginia Tech)

LYNDA NGUYEN
VIRGINIA TECH / CMDA

Rating and Rankings of Basketball Teams

The research conducted will compare various approaches to the rating and ranking of collegiate basketball teams. The systems of rankings will encompass the competitiveness and predictability surrounding March Madness. It will include methods such as Massey's method and Pomeroy's method in addition to various machine learning techniques. With statistical analysis through machine learning one will uncover the importance of features and learn their relationships. Machine learning will also determine how a team's past statistics can help determine predictability when facing new opponents. When looking at the environment that March Madness yields, there are multiple differences that the statistics of a team's season cannot account for. This study will allow one to investigate the importance of attributes versus models and raises the question if there is an upper limit to predictive quality.

Mentor: Lizette Zietsman (Mathematics, Virginia Tech)

TREVOR NIER
VIRGINIA TECH / MECHANICAL ENGINEERING

The Effect of Aligned Polyethylene Oxide (PEO) Nanofiber Coating on Ureteral Stents to Combat Microbial Adhesion

Microbial adhesion and biofilm formation are prevalent in both clinical and industrial settings and can be beneficial or detrimental. Biofilm formation on implantable medical devices poses serious problems since it causes up to 70% of nosocomial infections, which is the fourth leading cause of death in the U.S. at ~2 million cases annually. The most common type of nosocomial infections are urinary tract infections and 97% of these cases are associated with biofilm growth on urethral catheters and ureteral stents. Previous work by our lab has developed a strategy to combat microbial adhesion by precisely depositing aligned polymeric micro and nanoscale features onto surfaces in certain topographical sizes, shapes, and spacing to yield minimum microbial attachment density. In this work, we develop a polyethylene oxide (PEO)-based fiber coating to minimize the adhesion of uropathogenic E. coli on ureteral stents. To this end, we combine PEO with UV active crosslinker pentaerythritol triacrylate (PETA) to render the fibers insoluble in aqueous media. We developed an apparatus to facilitate the UV crosslinking of PEO nanofibers deposited on urinary stents. Bacterial adhesion on ureteral stents coated with varying nanofiber diameters and spacing is being studied and compared with that of the uncoated ureteral stents. The anticipated outcome is determining an optimal PEO nanofiber architecture that is most effective in reducing microbial adhesion and biofilm formation.

Mentor: Bahareh Behkam (Mechanical Engineering, Virginia Tech)

JARED A. OKADA
VIRGINIA TECH / SYSTEMS BIOLOGY

A Computational Approach to Characterizing the Interactions between Rcan1.4 and Raf1, Two Proteins Involved in Down Syndrome Tumor Regulation

Cell-signaling pathways and the associated protein-protein interactions are of interest in understanding healthy and diseased cell growth. Interestingly, individuals with Down Syndrome express a phenotype of tumor resistance of certain lung and liver cancers, observed through a reduction in vascular growth around the tumor growth sites. This work aims to identify key structural components involved in the interaction between Rcan1 isoform 4 (Rcan1.4), a protein upregulated in DS, and Raf1, a protein involved in regulating the Vascular Endothelial Growth Factor (VEGF) pathway. To characterize the interaction interface of Rcan1.4 and Raf1, computational approaches are necessary given a lack of structure of Rcan1.4 and a need to predict binding interfaces utilizing Protein-Protein Docking (PPD) and Molecular Dynamics (MD). A homology model for RCAN1.4 which was structurally consistent with information from the literature and was validated by energy and homology based protein structure validation servers. PPD results indicate, two main binding sites are located on Rcan1.4. The first region is located on a short beta sheet region from Leu 13 to Asp 19 which tended to bind to an alpha cluster on the C-terminus of Raf1. The second region is located on the C-terminal coiled region and tended to bind to an N-terminal beta sheet region in Raf1. MD will be done in order to further characterize the interaction dynamics and observe functional changes in Raf1 structure.

Mentor: Anne Brown (University Libraries, Virginia Tech)

HAYLEY E. OLIVER
VIRGINIA TECH / ENGLISH LITERATURE

Selfhood, Soulfulness, and Sexuality in Zora Neale Hurston's Their Eyes Were Watching God

Many readers of Zora Neale Hurston's Their Eyes Were Watching God find it difficult to reconcile the tension between Janie Crawford's canonization as a quintessential black feminist hero and her silent acceptance of the violent abuse she receives from her greatest love, Tea Cake. In order to reconcile this tension, one must better understand how Tea Cake encourages the development of Janie's subjectivity through spiritual and sexual means, such that Janie is enabled to communicate with her own soul. I do so by employing research housed in African American literary theory and black feminist theory, which includes the work of Zadie Smith, Patricia Hill Collins, Alice Walker, and Hurston herself. In this paper I illustrate how Janie's silent acceptance of Tea Cake's violence is ultimately understandable, considering Tea Cake's embodiment of the pear tree, under which Janie experiences a sexual awakening and a burgeoning journey of self-discovery. This link between Janie's sexuality, spirituality, and subjectivity revolutionized the literary depiction of black female sexuality. Janie chooses her own life over Tea Cake's, finds the ability to wrap the horizon around herself, and chooses which memories to keep and which to discard. This explains both why Janie remains silent in response to Tea Cake's violence and why she maintains a solid position in the canon as a quintessential black feminist hero.

Mentor: Dr. Gena Chandler-Smith (English Literature, Virginia Tech)

JOANNA OSBORNE
VIRGINIA TECH / ENGINEERING SCIENCE & MECHANICS
ANDREW CHAN
VIRGINIA TECH / COMPUTER SCIENCE
MICHAEL WILLS
VIRGINIA TECH / MATHEMATICS
BRADY BOLTON
VIRGINIA TECH / COMPUTER SCIENCE
CASSANDRA BASHAM
VIRGINIA TECH / ENGINEERING SCIENCE & MECHANICS
ZAID SALAMEH
VIRGINIA TECH / ENGINEERING SCIENCE & MECHANICS

Optimum snake locomotion

Snakes employ one of the most unique and highly adapted mechanisms of locomotion: lateral undulation. Lateral undulation gives snakes many degrees of freedom to adjust their locomotion to the terrain. This unique locomotion has been the object of extensive studies by biologists, mathematicians, and engineers. However, in all previous studies and developed models, it is assumed that the normal force between the snake body and ground remains constant. In this experimental and theoretical work we aimed to show that this assumption is not always valid and snakes could actively control the distribution of the normal force. Through active distribution of body weight, the efficiency of the locomotion could increase by about 20%. In this study, for the first time, we experimentally measure the normal force between the snake body and the ground on various points of their body during the locomotion. We also developed a computational frame work to find an optimum locomotion and normal force distribution for different friction coefficients.

Mentor: Hodjat Pendar (Biomedical Engineering & Mechanics)

MIKA K. PAGANI
VIRGINIA TECH / ENVIRONMENTAL SCIENCE

Halyomorpha halys feeding impact on industrial hemp yield and quality

Industrial hemp is gaining momentum in interest for its various sustainable and medicinal benefits. It is a common misconception that industrial hemp is immune and resistant to pest pressure - including insects. Currently, there are only anecdotal observations relating to damage from pest pressure and the effects of insect pests on industrial hemp yield. Studies are necessary to definitively identify the common regional agricultural pests which may pose a threat to the crop. In 2017, hemp field plots from several locations in Virginia were first sampled for insects and their damage. Several insect species were commonly encountered on hemp plants, including the brown marmorated stink bug (Halyomorpha halys). Effects of damage to hemp plants from this insect are unknown, so studies were initiated in 2018 to investigate further. Bugs were caged in varying densities for several weeks on seed heads of grain variety industrial hemp in field plots to document damage appearance and yield effects. Seeds were removed from plants in the laboratory, counted, and weighed to assess differences between treatments. In another study, bugs were reared on hemp seed heads in a lab setting from the second instar to adulthood. We found that bugs developed successfully to adulthood. Results from both studies have been analyzed and will be presented.

Mentors: Thomas Kuhar and Kadie Britt (Entomology, Virginia Tech)

KIRAT K. PANDHER
VIRGINIA TECH / ARCHITECTURE

Studying Building Envelope through the Works of two Indian Architects

The role of Indian-origin women architects internationally has been recognized but its scope has been limited to just that. As I pursue B.Arch with a minor in Construction in the US, my context and prior experience with the built-environment has been in India. The climatic variations, building materials, and economy of labor along with the precision of technology make the building envelope, techniques, and process different from what is commonly taught here. Through the Milka Bliznakov Prize, the IAWA provided an impetus to further my interest and use the archive to explore the lingering questions on the process of design and construction and the differences and similarities between the two countries. In an effort to reduce the gap in accessibility of information through materials, this initiative proposes to procure documents of the work of the two Indian-origin architects: Brinda Somaya and Anupama Kundoo for analysis and comparison. SNK Architects represents a diverse practice recognized for its innovation and sensitivity in design, seen through its large scale commercial projects along with restoration work. Anupama Kundoo's architectural innovation through material research lies in low environmental impact structures pursued through practice and academia. Her approach delves into the usage of waste materials, unskilled labor, and local communities. Both likened in the international community through their award-winning architecture practice.

Mentor: Donna Dunay (College of Architecture and Urban Studies, Virginia Tech)

TABITHA K. PARKS
VIRGINIA TECH / DIETETICS

FTO Gene and effects on obesity risk

Obesity is a fast-growing disease and affects different cultures in a large way. FTO was originally identified in a genome-wide scan that showed a strong risk of obesity in both heterozygous and homozygous carries of the mutant allele. The purpose of this research is to measure variation in the FTO gene in a population of students taking Metabolic Nutrition HNFE 4026. Specifically, the single nucleotide polymorphism, rs1421085 will be characterized in both DNA, and raw genotype data from volunteers who were given a 23andMe kit. To date, genomic DNA has been purified from volunteers, and all volunteers have completed their 23andMe analysis. Current studies are using PCR-based genotyping, and in silico population analysis of the class to measure the total number of volunteers that carry the variant. The hope as the research is continued is to be able to identify the single nucleotide polymorphism, rs1421085 in student's genomic and 23andMe DNA samples. From there, the direction will be to assess how this gene affects people in a practical way and examine more medical papers on the effect of the FTO gene and the singly nucleotide polymorphism, rs1421085.

Mentors: Dr. Deborah Good and Dr. Angela Anderson (Human Nutrition, Foods, and Exercise, Virginia Tech)

AINSLEY K. PATRICK
VIRGINIA TECH / PSYCHOLOGY

Sleep Difficulties in Youth with Specific Phobia

Objective: Individuals with anxiety disorders often report sleep difficulties. However, no study has assessed sleep difficulties in individuals with Specific Phobias (SP). The current study explored potential differences in sleep difficulties across and within SP subtypes. Methods: Data were collected from 131 participants (age range = 6-17, 60 females) who were diagnosed with the three most common subtypes of SP: Animal Type (dogs, insects, snakes), Environmental Type (darkness, water, storms), or Other Type SP (costume characters, loud noises). Sleep difficulties were measured by the sleep subscale of the Child Behavior Checklist (i.e. nightmares, sleeps less than most kids). Results: A one-way ANOVA between SP subtypes was significant, $F(2, 122)=8.75$, $p=<.001$; post hoc analyses indicated significant differences between the Animal and Environmental Types, $p =.001$, but not between Animal and Other Type, $p=.458$, or between Environmental and Other Type, $p=.238$. Specifically, youth with phobias of storms and the dark reported more sleep difficulties than youth with other types of phobias. Age and gender were not significant covariates in these analyses. Conclusions: These results indicate that the presence of an Environmental Type SP contributes to increased sleep difficulties. These results have implications for clinical assessment (e.g., understanding that sleep difficulties may inform other aspects of SP) and intervention (e.g., time of day of treatment).

Mentors: Thomas Ollendick (Psychology, Virginia Tech), Sarah Ryan (Psychology Graduate Student, Virginia Tech)

KAITLYN R. PAULCHELL
VIRGINIA TECH / BIOLOGICAL SYSTEMS ENGINEERING

Effect of Root Surface Sterilization on Plant Growth

There is a gap in research on sterilization methods for living terrestrial root systems. In this study, sterilization methods were compared to determine the effectiveness of each procedure and the impact of sterilization on plant health. Panicum virgatum roots were sterilized with 1% NaClO for 2 minutes, 1% NaClO for 5 minutes, 5% NaClO for 30 seconds, and UV light for 30 minutes. Control samples were treated with DI water. Each treatment was replicated three times. The success of sterilization was tested through agar plating; however, the results were inconclusive. On average, plants that underwent treatment with 1% NaClO for 2 minutes had the highest average root length density (RLD) and aboveground biomass for all treatments including the control. The RLD for plants treated with 1% NaClO for 2 minutes was significantly different from other NaClO treatments; however, not from control samples. For aboveground biomass, the 1% NaClO for 2 minutes treatment was only significantly different from the 5% NaClO for 30 seconds treatment. The effects of sterilization on plant growth are dependant on the concentration and time of sterilization. This suggests that sterilization may reduce competition in the rhizome and promote plant growth when sterilization is beneath toxicity levels.

Mentor: Dr. Thompson (Biological Systems Engineering, Virginia Tech)

MADELEINE C. PAULSEN
VIRGINIA TECH / COGNITIVE AND BEHAVIORAL NEUROSCIENCE
DYLAN T. QUETEL
VIRGINIA TECH / COGNITIVE AND BEHAVIORAL NEUROSCIENCE

How Can A Website Increase User Engagement? A Comprehensive Study of the Relative Influence of Multimedia Design

As internet usage has increased, interest has grown in better understanding user engagement, specifically as it pertains to websites. User engagement can be measured by the time spent on a website and how interested someone is in the website. User engagement is affected by an individual's feelings and level of motivation (i.e. individual characteristics) and through computer interface, such as website speed and visuals (i.e. technological factors). Given the importance of websites on human behavior, we explore how website organization shapes user engagement. We varied website design by increasing the amount of visual information (i.e. multimedia) present. We created 4 websites: a control website with only text (i.e. no images, animations, etc.), a 2nd website with additional images, a 3rd website with images and animations and a 4th website with images, animations, and videos. All websites were about a non-profit educating school children on robotics. The websites were created through Wix to avoid user familiarity and controversial topics. Participants were undergraduates and given 10 minutes to browse. Afterwards, user engagement was measured via the User Engagement Scale and a quiz to assess information retained. We hypothesized that as the amount of multimedia increases, users are more engaged with the website, which will lead to greater information retention. Our results support our hypothesis and indicate there is greater engagement within the 4th website.

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

KSENIA PEREVERZEVA
VIRGINIA TECH / BIOLOGICAL SCIENCES

Comparing plant uses among coastal plain cultures in colonial Virginia

The collision of three distinct cultures in colonial Virginia represents an ideal scenario to quantify medicinal plant diversity and cultural exchange. We documented the medicinal plants used by Native American tribes (e.g., Powhatan and Rappahannock), European settlers, and African-American slaves during the colonial period (1607 â€“ 1776 C.E) of Virginia from peer-reviewed literature, ethnobotanical databases, and historical documents. All medicinal species were scored for their usage for 19 medical categories. We used PHYLOCOM to generate a phylogeny comprising all known coastal plain species in Virginia as well as the medicinal plant species used by the colonial Virginia cultures. We identified "hot nodes" on the phylogeny that are overrepresented with medicinal species, which could exhibit promising candidates for biomedical inquiry. We also quantified the similarity of the three culture's medicinal floras. We calculated the pairwise mean phylogenetic distance among all culture's medicinal plant sets. In contrast to previous studies that assessed shared plant uses among far-flung cultures, these results will serve as an empirical reference for the similarity of sympatric cultures' ethnobotanical traditions. This project also adds a new dimension to our historical knowledge of medicinal plants and cultural exchange within colonial Virginia.

Mentor: Jordan Metzgar (Biological Sciences, Virginia Tech)

AUBREY N. PHARES
VIRGINIA TECH / COGNITIVE AND BEHAVIORAL NEUROSCIENCE

What expressions of anxiety are most prevalent among individuals with Autism Spectrum Disorder?

Anxiety is common in individuals with Autism Spectrum Disorder (ASD; Wood & Gadow, 2010), but it's difficult to distinguish between anxiety symptoms and ASD deficits. Also difficult is assessing potential anxiety in minimally-verbal (MV) individuals with ASD, which is why the development of assessments for MV-ASD is necessary. In the current study, we sought to identify the most common anxious behaviors among children with MV-ASD. Participants included 26 individuals with ASD, ages 2-15 (mean: ~4.12 years, sex: 80.77% male). Within the Autism Diagnostic Observation Schedule (ADOS-2; Lord et al., 2000), six specific anxious behaviors were evaluated: fear arousal, physical avoidance, proximity seeking, exaggerated startle, separation distress, and latency to touch. These measures were taken from the Anxiety Dimensional Observation Schedule (AnxDOS; Mian et al., 2015), designed to evaluate anxiety in children. Codes consisted of a rating between 0 and 3, and the higher ratings correlated with more quantitative and severe displays of a behavior. Results indicated that physical avoidance (61.54%) and proximity seeking (65.38%) were the most prevalent anxiety behaviors when compared to fear arousal (38.46%), exaggerated startle (30.77%), separation distress (15.38%), and latency to touch (19.23%). Through the identification of physical avoidance and proximity seeking as two of the most prominent anxious behaviors, these may be targeted in future assessments of anxiety in MV-ASD.

Mentors: Dr. Angela Scarpa and Ashley Muskett (Psychology, Virginia Tech)

RACHEL L. PHILLIPS
VIRGINIA TECH / HUMAN DEVELOPMENT
VICTORIA E. FREIBERG
VIRGINIA TECH / PSYCHOLOGY

Child Emotion Regulation: Contributions of Parental Emotion Coaching

Emotion regulation (ER), or ability to control emotions, is an important skill for children. Sensitive parenting, including behaviors responsive to children's interests, has been associated with more optimal ER (Spinrad et al., 2007). According to Gottman & Katz's (1996) meta-emotion philosophy, parents can be encouraging or dismissing of children's emotions. Another important factor is parents' beliefs about emotions (their thoughts about the value, guidance, and control of emotions, Halberstadt et al., 2013). Our research question examined how these parenting factors interact to predict child ER. If parents demonstrate sensitivity and supportive emotion coaching, their children are hypothesized to display better ER when they are older, but the effects of parental behavior is predicted to vary depending on parental beliefs about emotion. We hypothesized that parent beliefs about emotions would moderate the effect of parenting on child ER. At the preschool assessment, 156 parents and children completed an emotion talk where they discussed two events (one when child was happy and one when upset) where parent sensitivity and emotion coaching were coded. Parental beliefs were reported on the Parents' Belief about Children's Emotions Questionnaire (Halberstadt et al., 2013). School-aged children's ER was measured in a locked box frustration task. After preliminary analyses, we will statistically test the proposed moderation model and discuss the implications of the findings.

Mentor: *D*r. Cynthia Smith (Human Development and Family Science, Virginia Tech)

NIKITA A. PIKE
VIRGINIA TECH / CLINICAL NEUROSCIENCE
JULIAN A. SAUVAGE
VIRGINIA TECH / ECONOMICS

How Individual Ratings of Team Cohesion Change Over Time

Teams are an essential part of everyday life. From sports team to medical teams, there's an underlying interest in how teams interact and form togetherness. Theory on group dynamics suggests that groups transition from separate individuals to a stable, cohesive unit. Unfortunately, this process is rarely studied because most teams used in research have already been formed or are studied once. Based on this theory, we predicted that as newly formed groups work together over time, individuals' ratings of their group interactions will become more stable. The purpose of our study was to observe how teams that are newly formed function together in a short period of time. Our study involved four people playing a team video game for 10 minutes. After they were done playing, each individual watched a video of themselves interacting with their teammates while playing the game. While they watched the video, each individual continuously rated their team cohesion as they saw it change. We then accumulated 10 data points by averaging the ratings across each of the first 10 minutes. We examined the relationship between each of the 10 ratings over time, and found that ratings were most strongly related to the previous rating (e.g. Time 1 - Time 2). As theorized we found that the relationships among subsequent ratings over time grew stronger, suggesting that as teams worked together, their understanding of their interactions became more stable. We plan to discuss what predicts these changes.

Mentors: Dr. Roseanne Foti and Bryan Acton (Psychology, Virginia Tech)

GABBY C. PULLER
VIRGINIA TECH / BIOLOGICAL SCIENCES

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

Arabidopsis thaliana, commonly known as the thale cress or mouse-ear cress, is a small flowering plant frequently used as a model organism for plant molecular genetics. The flavonoid pathway of Arabidopsis has especially been a featured area of study. This is due to the practical importance of flavonoids for agriculture and human health and the simplicity of the pathway in Arabidopsis relative to other plant species. Chalcone synthase (CHS) is the first enzyme in this pathway and is therefore a key factor in flavonoid biosynthesis. In addition to its involvement in the flavonoid pathway, there may also be a link between CHS and gene expression in the nucleus, though the underlying mechanism is not yet understood. To explore this further, the Winkel lab has generated an RNA-seq data set for the CHS-deficient Arabidopsis mutant, tt4, highlighting changes in expression levels of genes between mutant and wild-type plants. The current project has expanded previous computational analysis of the data set and identification of genes of interest. Surprisingly, a substantial number were found to be associated with control of the circadian clock. qRT-PCR is being used to validate differences in the transcript levels of these genes in tt4, including the key circadian regulator CCA1. This work forms the basis for future experiments aimed at understanding the mechanisms underlying this newly-discovered connection between flavonoids and the circadian clock.

Mentors: Brenda Winkel (Biological Sciences, Virginia Tech), Sherry Hildreth (Biological Sciences and Biochemistry, Virginia Tech)

DANIEL J. PURCELL
VIRGINIA TECH / BIOMEDICAL SCIENCES

The role of connexin 43 during epithelial to mesenchymal transition

In the United States alone, there was an estimated 1.7 million new cancer cases for 2017 alongside an average death rate of 36% for the 15 million people living with the disease today. The genetic controls and biochemical mechanisms underlying a cell's ability to invade surrounding tissues and spread malignant tumors throughout the body have been areas of intensive research. In these studies, activation of epithelial to mesenchymal transition (EMT) has been proposed as the critical mechanism for this metastatic process. Connexin43 (Cx43) is the most ubiquitously expressed human gap junction protein and is known to act as a tumor suppressor during the early stages of carcinoma development. We question whether the presence of Cx43 gap junctions is required to facilitate EMT in the normal murine mammary gland (NMuMG) cell line and therefore necessary for cancer metastasis. Western blot densitometry was used for quantitative analysis in knockout vs wild-type cells, followed by two functional tests to determine the capacity for migration and invasion. Our current biochemical data suggests that knockout of Gja1 prevents TGF-_ induced expression of fibronectin within the NMuMG cell line; however, functional analysis shows increased migratory and invasive abilities of epithelial cells in the absence of Cx43 and indicates the upregulation of a metastatic signaling pathway when Gja1 is not present. We are now performing additional trials in order to ratify or oppose these findings.

Mentors: Dr. James Smyth (Center for Heart and Regenerative Medicine Research, Fralin Biomedical Research Institute at VTC), Michael Zeitz (Ph.D. Research Scientist, Farlin Biomedical Research Institute at VTC), Patrick Calhoun (Graduate Student, Fralin Biomedical Research Institute at VTC)

ERIN R. QUESENBERRY
VIRGINIA TECH / WILDLIFE CONSERVATION

Using the Virginia Tech Campus as a Laboratory for Assessing Dispersal Patterns and Biases in Land Plants

Plant colonization and succession has been well studied across many natural ecosystems; however, these processes are much less understood in anthropogenic ecosystems. We inventoried the flora of buildings on the Virginia Tech's campus in Blacksburg, VA to determine the importance of dispersal strategy and source populations' distance from colonization sites. The study system is highly dynamic, with brick, concrete, and Hokie Stone buildings dating to 1872. Complications that alter and reset the colonization process include constant turnover as buildings are maintained and renovated. We sampled and collected study vouchers from 121 buildings, recording and species, coverage, and aspect of mosses and vascular plants on the buildings. Herbarium specimens were inventoried to find source populations. It was expected that most species would be wind dispersed, primary colonizers, with nearby source populations but some (like ferns and mosses with minute diaspores) potentially farther. We expected non-wind dispersed species to be rare and of low abundance. Identified specimens include 10 species of mosses, four species of ferns, and nine species of flowering plant. These species were then searched for diaspore type and dispersal ability. An ANOVA test of variables including dispersal distance, percentage of buildings colonized, and building age will determine biases in colonization success. These data will expand our understanding of colonization in anthropogenic ecosystems.

Mentor: Jordan Metzgar (Biological Sciences, Virginia Tech)

FERNANDO RAMOS-DIAZ
VIRGINIA TECH / PHYSICS
POLINA SOBOL
VIRGINIA TECH / PHYSICS
PRANAV PATEL
VIRGINIA TECH / COMPUTATIONAL MODELING AND DATA ANALYTICS
GENNA CZYZNIKIEWICZ
VIRGINIA TECH / BIOLOGICAL SCIENCES
SAM RIZZUTO
VIRGINIA TECH / COMPUTATIONAL MODELING AND DATA ANALYTICS

Geiger Counter Studio Project

The Curie and Da Vinci Living Learning Community provides students with the opportunity to start developing skills that are required of college graduates and necessary to tackle real-world challenges. This is accomplished through the use of semester-long collaborative projects. Our project involves the use of Rhino and R software, a laser cutter, and aid from a project coordinator to create a Geiger counter. We will use this Geiger counter to detect and measure radiation levels on the Virginia Tech campus, including in Hahn Hall, the basement of Robeson Hall, and the power plant near the Surge building. As part of the project design and creation process, we are learning how to communicate effectively within and across teams, and manage our responses to project setbacks. We will present the final Geiger counter and information on any detected radiation, and discuss our learning process.

Mentor: Lori Blanc (Biological Sciences, Curie and Da Vinci LLC, Virginia Tech)

AMBER R. N. REANEY
VIRGINIA TECH / MICROBIOLOGY

Persistence of antimicrobial activity in oyster mushroom herbarium specimens

Oyster mushrooms (Pleurotus genus) are edible higher Basidiomycete fungi that are grown commercially for human consumption worldwide. Recent studies have identified the antimicrobial compound 3-(2-aminophenylthio)-3-hydroxypropanoic acid in extracts from mature tree oyster mushroom fruiting bodies. Our study sought to answer whether long-term preservation methods degraded the antimicrobial properties of the oyster mushroom fruiting body by measuring the zone of inhibition created by both live and preserved oyster mushroom extracts on a lawn of a non-pathogenic, non-antibiotic resistant Escherichia coli. Tree oyster (P. ostreatus), king oyster (P. ernygnii) and Indian oyster (P. pulmonarius) mushrooms were also included in this study to provide cross-species results for comparison in antimicrobial activity. Live samples were grown immediately prior to extraction and preserved material was gathered from Virginia Tech's Massey Herbarium (VPI). We expect the largest zone of inhibitions to be from live oyster species with proportional decreases in zone of inhibitions correlated with age of specimens. Finding any degradation of bactericidal activity of the fruiting body after the cease of enzymatic processes and herbarium preservation will provide prospective knowledge for future pharmaceutical development for when to extract antimicrobial materials from harvested fruiting bodies, or whether herbarium preservation enhances fruiting body utility as an antimicrobial agent.

Mentor: Jordan Metzgar (Biological Sciences, Virginia Tech)

TYLER RICKS
VIRGINIA TECH / APSC
ZACH CUSHING
VIRGINIA TECH / APSC
ROSALIE GUDE
VIRGINIA TECH / APSC
TIMMY MOORE
VIRGINIA TECH / APSC
LINDSAY HINKS
VIRGINIA TECH / APSC
HAILEY SMITH
VIRGINIA TECH / APSC

2D Anatomical Model of a Bovine Heart

As part of the Da Vinci Living Learning Community spring learning experience, we were tasked with completion of a collaborative project using our residential makerspace. Our project involved the use of a laser cutter to create a labeled, two-dimensional model of the bovine heart with colored acrylic. The model is to be used as an educational tool to provide information on the scale, anatomy, and flow of oxygenated and deoxygenated blood. We used a laser cutter to create the models, and used arrows and bullets to display information relating the bovine heart to the human heart. We will present our completed anatomical models and discuss our individual and shared learning experiences with the project.

Mentor: Lori Blanc (Biological Sciences, Curie & Da Vinci LLC, Virginia Tech)

DANIEL RIDDLE
VIRGINIA TECH / HUMAN NUTRITION FOODS AND EXERCISE
MEGAN CARTER
VIRGINIA TECH / HUMAN NUTRITION FOODS AND EXERCISE
KYLE REGA
VIRGINIA TECH / BIOCHEMISTRY
LAURA MILLER
VIRGINIA TECH / HUMAN NUTRITION FOODS AND EXERCISE

Anatomical Model of the Pancreas

As students in the Curie and Da Vinci Living Learning Community, our group embarked on a semester-long collaborative project to create an anatomical model of a human organ system. The overall purpose of the project is to develop our skills in collaboration, time management, and reflection while creating a finished product, thus ensuring that the group not only learns more about scientific concepts but also how to work well within a team. Our project goals involve mutual group accountability to complete background research on the pancreas and surrounding organs, and using Rhino software to produce drawings of organs to be used for laser cutting. Another goal is to reflect on problems encountered following each step in the project. We started by making a sketch of the pancreas and surrounding organs with labels of anatomy and blood flow. We imported this sketch into Rhino software and used the digital drawings to cut acrylic panels in a laser cutter machine. We will produce two panels, one with the anatomy of the pancreas and the other showing insulin/glycogen flow. We will present the final product and discuss problems, methods, and solutions in association with our learning process.

Mentor: Lori Blanc (Biological Sciences, Curie and Da Vinci LLC, Virginia Tech)

ADRIAN E. RIDINGS
VIRGINIA TECH / BIOCHEMISTRY

Accessibility of Mental Health Care to Queer and Transgender Students

Abstract: Queer and transgender individuals are impacted disproportionately by mental health issues, due to the effects of minority stress. Despite this, data and narrative indicate that mental health services are frequently inaccessible to LGBTQ individuals, an issue embedded in the history of pathologization and medicalization of queer and transgender identities. Despite improvements in the past half-century, queer and transgender individuals still face significant barriers to accessing mental health care. This study investigates how such barriers function on college campuses, and, from a methodological standpoint, how they may be identified, understood, and changed. A gap analysis of Cook Counseling Center (CCC) policy, utilizing the 2019 HRC Healthcare Equality Index (HEI), identified areas where CCC policy differed from that recommended for queer and transgender accessibility. Survey instruments assessing student perception and experience of practice and policy at Cook Counseling Center were then adapted and developed using the HEI, American Counseling Association competencies for work with LGBTQ clients, and American Psychological Association guidelines for work with LGBTQ clients. This survey instrument enables collection of ethnographic data, supplementing gap analysis results in order to investigate strengths and barriers in queer and transgender mental health care access.

Mentor: Dr. Rebecca Hester (Science, Technology, and Society, Virginia Tech)

JACOB E. RINEY
VIRGINIA TECH / COMPUTER SCIENCE

Reconstructing climate change responses of the fern genus Cryptogramma from the Last Glacial Maximum and onwards

The rock-loving fern genus Cryptogramma is an ideal candidate to study climate change impacts due to their preference for climate-sensitive habitats, such as sky islands and glacial margins. We focused on the C. acrostichoides complex: C. acrostichoides, C. raddeana, and their allotetraploid, C. sitchensis. Presence data were collected from herbarium collections, and ecological niche model (ENM) projections were created using WorldClim bioclimatic variables. We generated ENMs predicting suitable habitat in the present day, then projected our models to the last glacial maximum (LGM; 21kya) using paleo-climate data. We also projected our models to future climate scenarios, allowing us to identify suitable habitats for each species and focus conservation efforts. We found that C. sitchensis and C. acrostichoides most likely shared coastal refugia in the Coastal Pacific Northwest during the LGM, and that populations in the western contiguous USA will face critical conservation threats in the near future. We then assessed these results using molecular phylogeographic analyses. We constructed a chronogram using 40 accessions from eight Cryptogramma species and six outgroup taxa. We reconstructed the phylogeographic history of C. acrostichoides and C. sitchensis during the Pleistocene and Holocene using the chronogram and accession range data. These results also support the long-term presence of C. acrostichoides and C. sitchensis in the Coastal Pacific Northwest.

Mentor: Jordan Metzgar (Biological Sciences, Virginia Tech)

BLAKE ROBERTS
VIRGINIA TECH / LANDSCAPE ARCHITECTURE

Scioto River Metro Park and Ecologic Center

The purpose of this conceptual design project is to re-establish a native urban ecology on a disturbed site, that will foster ecosystem services, while educating the public on forest succession. This project explores the idea of using principles of forest succession as a guide for the design of a new metropolitan park in Columbus, Ohio. The new park will connect to the larger urban forest network, bolstering the ecologic vitality of a fragmented forest system as well as providing pedestrian connectivity between parks. The primary goal of the design is to promote environmental education, ecologic restoration, and social interactions as capital of value to the city. To achieve this goal, the project involves analysis of techniques used in the design of existing education facilities, nature parks, and habitat restoration projects. A culmination of scientific research and precedent case studies laid the foundation for a comprehensive master-plan of the park and a detailed site design of the main education center. Ultimately, the conclusion drawn from this project is that a phased succession approach to site reclamation allows for a fuller educational experience, allowing people to experience a rich mosaic of ecotones during their visit. Also, designing to encourage succession creates a dynamic place as vegetation turns over revealing new experiences for future generations of visitors.

Mentor: Mintai Kim (Landscape Architecture, Virginia Tech)

ALEXANDRA D. RUSSELL
VIRGINIA TECH / MINING ENGINEERING

Characterization of Rare Earth Elements in Fine Coal Refuse as a Function of Size Using Ultrafine Size Classes

This project aims to utilize advanced characterization techniques, including SEM-EDX and ICP-MS to identify the modes of occurrence and mineralization of REEs in fine coal refuse. Prior research has shown that multiple coal basins within the U.S. have elevated REE concentrations compared to the total average REE content of the Earth's crust.1 In some cases, the REE content of coal and coal byproducts approaches that of commercial REE deposits; however, this prior work has not specifically addressed the form or mode of occurrence of these elements in the various coal basins. Coal refuse samples were obtained from the thickener underflow (TUF) stream from a Central Appalachian coal preparation facility. SEM analysis was performed on samples before various separation processes to identify the REE mineralogy and grain size. Pending these results, the material was then sized to narrow and fine size fractions, to further identify any trends of REE with respect to particle size. Of particular note in this study is the use of ultra-fine size fractions, namely 5 x 0, 10 x 5, and 15 x 10 microns (Figure 1). These additional size classes provided added fidelity to the fine fractions where REEs likely reside. Preliminary results from SEM-EDX showed that the rare earth minerals were often extremely fine-grained with typical particle sizes less than 10 microns (Figure 2). Given this result, the follow-on study targeted the ultra-fine size classes for further evaluation.

Mentor: Aaron Noble (Mining Engineering, Virginia Tech)

MICHAEL R. SANTOS
VIRGINIA TECH / BIOLOGICAL SCIENCES

Microfluidic platform to quantify single-cell circadian rhythms

The circadian clock is a genetically encoded mechanism that generates persistent ~24-hour rhythms in behavior, physiology, and metabolism across many species. Traditional methods for studying circadian rhythm, such as measuring bioluminescence in a Lumicycle, rely in recording circadian oscillations in a large population of cells. This is limiting because of the number of conditions that can be tested at once making certain experiments impossible, and it lacks the resolution required to observe circadian rhythms in individual cells. In this study, we show the design and proof-of-concept validation of a microfluidic platform to quantify circadian rhythms at the single-cell resolution. We have designed a microfluidic platform where U2OS BMAL1::LUC cells can be cultured in a nanoliter-sized chamber. The chamber is attached to microfluidic channels so that cells can be synchronized with dexamethasone. We then monitored the expression of the bioluminescence reporter (BMAL1::LUC) in DMEM media over a period of 24 to 48 hours. We recorded bright field images at 20X using a Nikon-TiE microscope equipped with a black box biochamber. We used Matlab and Image J to quantify the bioluminescence of individual U2OS cells overtime. Our results show changing bioluminescence intensity as cells' circadian rhythm oscillates throughout the day. We envision our work will help to study the performance of FDA-approved chemotherapy drugs and hypnotic drugs for jet-lag-associated conditions.

Mentors: Dr. Caroline Jones, Kyle Anderson, Maryam Moarefian, Xianlin Zou, and Carla V. Finkielstein (Biological Sciences, Virginia Tech)

MOLLY S. SAYLES
VIRGINIA TECH / CIVIL ENGINEERING
MORGAN E. CAMPER
VIRGINIA TECH / BIOLOGICAL SYSTEMS ENGINEERING
LEECILING CHEA
VIRGINIA TECH / COMPUTER SCIENCE
NATHAN MOELIONO
VIRGINIA TECH / COMPUTER ENGINEERING
DERIK R. ARONE
VIRGINIA TECH / ELECTRICAL ENGINEERING

Interdisciplinary Solutions for the Problem of Facilitating Communication in a Real Time Water and Weather Monitoring System

The Learning Enhanced Watershed Assessment System (LEWAS) is a real-time environmental monitoring system located at the base of the Webb Branch Watershed that collects weather, water quality, and and water quantity data using different sensors and equipment. An interdisciplinary team of students in civil engineering, biological systems engineering, computer science, computer engineering, and electrical engineering work to maintain and improve upon the system. The lab provides a unique space for these undergraduate students to engage in real-world applications of what they learn in class. In this presentation, we highlight the challenges of maintaining the system and the interdisciplinary nature of the solutions. In particular, we focus on ensuring communication between sensors and the raspberry pi, and how the team members critically engage with the system to address various technical problems. Each member of the team uses their respective background to isolate the part of the system in which the problem exists. The civil engineering and biological systems engineering students calibrate and monitor the values of the sensors for weather, water quality, and water quantity. The computer engineering and computer science students ensure that the scripts and physical connections from the sensors to the raspberry pi are not the source of the issues. The solutions to these problems are anticipated to be the return of the fully operational online monitoring system.

Mentor: Dr. Vinod K. Lohani (Engineering Education, Virginia Tech)

JACOB SCHAUM
VIRGINIA TECH / CLINICAL NEUROSCIENCE
LANA WATTS
VIRGINIA TECH / HUMAN NUTRITION FOODS AND EXERCISE
KEVIN MIKITA
VIRGINIA TECH / BIOCHEMISTRY
DAVID LESKO
VIRGINIA TECH / BIOCHEMISTRY
KEVIN GEIRAN
VIRGINIA TECH / BIOLOGICAL SCIENCES
CHRIS KISER
VIRGINIA TECH / CHEMISTRY

Rocket Project: Curiosity to shoot for the stars

In the Curie and Da Vinci Living Learning Community, first-year students select a project to complete for the spring semester. Our group selected a project that involved researching and building a functional rocket, and in doing so we learned how to work together as a group. This project is designed to give us team experience in research, development, production, and launch of our rocket that we can reflect on and use towards our academic and professional goals. Through regular meetings throughout this semester, we researched, designed, and constructed a rocket. We will present the rocket and data from the launch, and will discuss our results, methods, and the experiences that each of us have gained over the course of the project.

Mentor: Lori Blanc (Biological Sciences, Curie and Da Vinci LLC, Virginia Tech)

CAMBRIE M. SCHUMACHER
VIRGINIA TECH / ANIMAL AND POULTRY SCIENCE

Evaluation of the effect of essential amino acids on muscle and mammary gene expression

The overuse of certain nutrients such as nitrogen found in protein can have negative effects on the ecosystem and on the feed efficiency of cattle. Dairy cattle on average convert 25% of consumed nitrogen into meat and milk while the remaining 75% is excreted into the environment. Previously, eight lactating cows were fed a low protein diet and subjected to four treatments by jugular infusion consisting of saline (CON), methionine, lysine and histidine (MKH), isoleucine and leucine (IL), and the combination of MKH and IL. Three of the four treatments increased milk protein yield. The use of polymerase chain reaction (PCR) to analyze the gene expression of muscle and mammary tissue from these cows could prove useful to trace the origins of how and why milk protein yield increased. Understanding the cell regulatory network controlling protein synthesis in muscle and dairy cows could help identify how essential amino acids (EAA) regulate milk protein synthesis. This understanding can be leveraged to improve diet formulation to optimize protein feeding and improve protein efficiency in dairy cows.

Mentor: Mark Hanigan (Dairy Science, Virginia Tech)

ROBERT B. SHELTON
VIRGINIA TECH / INDUSTRIAL AND SYSTEMS ENGINEERING
NATHAN L. SMITH
VIRGINIA TECH / INDUSTRIAL AND SYSTEMS ENGINEERING
BENJAMIN M. HADINGER
VIRGINIA TECH / COMPUTER SCIENCE

Biomass Feedstock Logistics

The goal of this research project is to solve a general class of logistics problems related to sustainable biofuels. We created a tool wherein any biofuel stakeholder with an internet connection could generate customized results for their supply chain. This tool is based on an optimization-simulation framework. This research is important because, currently, around sixty percent of the cost of creating sustainable biofuels, from crops such as sorghum, switchgrass, or corn stover, is related to transportation. The research of the Biomass Feedstock Logistics team aims to provide stakeholders a methodology for reducing this cost in order to make biofuels a competitive alternative to fossil fuels. The result of this research is a prototype website that helps users solve hub and spoke logistics models interactively. The development of this site relies on an understanding of mixed integer programming, stochastic simulation, and modern software development.

Mentor: Subhash Sarin (Industrial and Systems Engineering, Virginia Tech)

WENTING SHI
VIRGINIA TECH / CHEMICAL ENGINEERING

Development of Drug-Loaded Optical Fibers for Cancer Therapy

Breast cancer is the most prevalent cancer in women. Among the many subtypes of breast cancer, triple-negative breast cancer is considered highly invasive with an increased risk of recurrence. To address the relapse of this type of tumor, a triggerable and sustained drug delivery system is desired to develop. During the research, we build a flexible polymer/ drug integrated optical fiber which can respond to external energy sources for drug delivery over an extended duration. The fiber is coated by biodegradable polymers, such as PLA and PLGA, together with a therapeutic agent â€“ verteporfin. The coated fiber can continuously provide verteporfin in vitro over two weeks within the desired drug concentration all the time. Then, based on HPLC analysis, we perform a drug delivery profile which quantitively relates the released drug concentration versus time. According to the nature of verteporfin as a photosensitizer, the near-infrared (NIR) light is applied to activate the drug and then trigger the cancer treatment as NIR shinning onto the target tumors. The anticipated outcome of the project is to provide therapeutic agent under an external energy control and over a long period. Therefore, it achieves the ideas of triggerable and sustained drug delivery and then attains significant benefits for cancer therapy.

Mentors: Dr. Rong Tong and Ai Lin Chin (Chemical Engineering, Virginia Tech)

ALEX D. SIMON
VIRGINIA TECH / ENGINEERING SCIENCE AND MECHANICS

Thermally-enhanced Histotripsy for the Non-invasive Ablation of Fibrous Tumors

Histotripsy is a non-invasive, non-thermal ablation method that uses focused ultrasound (FUS) to destroy targeted tumors with millimeter precision. Histotripsy is currently being developed for numerous clinical applications including cancer treatment. However, due to its mechanical mechanism, it is less effected in fibrous tissues due to their higher mechanical strength. This current study addresses this limitation by developing a thermally-enhanced histotripsy method capable of ablating stiff tissues that are primarily collagenous in composition. We hypothesize that thermal FUS pre-treatment (60oC) (tFUS) will denature tissue collagen, reduce stiffness, and increase the tissue susceptibility to histotripsy. To test this, we performed benchtop experiments in excised swine liver and tongue. The stiffness of each sample was measured using shear wave elastography before and after tFUS was applied to the tissues, with results demonstrating significant decreases in tissue stiffness after tFUS. In addition, experiments demonstrated reduction in stiffness increased as duration of tFUS procedure was increased from 3 to 8 mins. More specifically, liver stiffness dropped from 18 kPa at body temperature (37oC) to 8 kPa after tFUS was applied for 8 mins. Similarly, tongue stiffness dropped from 50kPa to 24kPa using the same parameters. These results show that a thermal pretreatment using HIFU can decrease stiffness sufficiently to enhance tissue susceptibility to histotripsy.

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

SADYE E. SOFFIN
VIRGINIA TECH / ANIMAL AND POULTRY SCIENCES

The effects of supplementing polyunsaturated fatty acids on bovine CT1 cell transcript expression

Previous research indicates that polyunsaturated fatty acid (PUFA) supplementation can improve the reproductive performance of cattle. Correct supplementation can reduce pregnancy losses, increase milk production, and allow cows to maintain a steady feed intake (Reis et al., 2012). However, less is known about the effect of PUFAs on a cellular level in embryogenesis. Bovine CT1 cells are the first to differentiate during embryogenesis, making them a prime candidate for this exploration. CT1 cells are trophectoderm-derived trophoblast cells that form the outer layer of the developing blastocyst. They serve as a nutrient source for the growing embryo and contribute to the development of the placenta. For this development to occur, there are important proteins involved in fatty acid transport within the placental tissue. This study investigated six of these proteins: CD36, FATP6, FATP3, FABPpm, PPARA, PPARG (Jones et al., 2014). Using quantitative polymerase chain reaction, this study explored the effects of arachidonic acid (AA) and docosahexaenoic acid (DHA) on the proliferation of bovine CT1 cells by quantifying the expression of these proteins. It was found that CD36, FATP6, and PPARG were best expressed at a 100 micromolar concentration of DHA, while PPARA, FATP3, and FABPpm were best expressed at a 100 micromolar concentration of AA. This data can contribute to the knowledge of PUFA diet supplementation in cattle to improve early gestation factors.

Mentor: Alan Ealy (Animal and Poultry Sciences, Virginia Tech)

SHANNON SPARKS
VIRGINIA TECH / BIOLOGY
CARISSA ROBERTS
VIRGINIA TECH / BIOLOGY
SARAH MORRIS
VIRGINIA TECH / BIOLGY
REBECCA MARDIS
VIRGINIA TECH / CLINICAL NEUROSCIENCE
ALLEGRA LAZZAROTO
VIRGINIA TECH / BIOLOGY

The Effect of Water Availability on Growth of Mutant Arabidopsis Plants

Experimental analysis of the Arabidopsis plant allows for the determination of the function of a gene that produces chalcone synthase, which is associated with flavonoid biosynthesis, the transport of the hormone auxin, and root gravitropism. We are conducting this analysis as part of our involvement in the Curie and Da Vinci Science Living Learning Community (LLC). Students in this LLC are responsible for the completion of a collaborative project that encourages the development of skills critical to the practice of science. The purpose of this project is to contribute to scientific knowledge through participation in data collection and experimentation using the model of citizen science. To test gene function, we subjected both wild type and mutated Arabidopsis deficient in chalcone synthase to varying levels of water. We predicted that the wild type would be slightly larger than the mutant Arabidopsis and have more leaves and flowers across watering levels. We will present the outcome of our analyses and discuss differences in Arabidopsis growth in response to drought and flood conditions.

Mentor: Lori Blanc (Biology, Virginia Tech)

MARILYN J. STEINBACH
VIRGINIA TECH / BIOLOGY
MARIAM QUATTARA
VIRGINIA TECH / PSYCHOLOGY
JINYUE LUO
VIRGINIA TECH / NEUROSCIENCE
LEXIE HACKMAN
VIRGINIA TECH / NEUROSCIENCE

A Neurophysiological Investigation of Boredom

Boredom, as a behavioral and neuropsychological response, is a misunderstood and under researched phenomenon that pervades human experience. Research has shown that the feeling of boredom is associated with several psychological and medical health issues, including ADHD/ADD, depression, anxiety, and certain traumatic brain injuries. The proposed study looked to provide evidence for a physiological definition and explore the neural correlates associated with boredom by analyzing biophysiological response to an induced boredom state. Using a normed task demonstrated to elicit boredom in participants, biophysiological measures were obtained. Based upon capacity theory and the proposed neural circuitry recruited during the induction task, it was hypothesized that frontal regulatory control of posterior cortical regions via the projection fibers would decrease due to the neural demand required to maintain attentional control during the boredom paradigm. The results of this cortical release of posterior neural structures responsible for sympathetic control would therefor result in increased cardiac activity.Â To test this hypothesis, participants were seated in a comfortable room, and administered the experimental procedure with baseline-task-baseline recordings of blood pressure obtained. Results indicated a significant effect across variables with F = 4.957, p = .017. Within subject contrasts revealed significance between the boredom induction paradigm and the second baseline.

Mentors: Dr. David Harrison, Benjamin B Devore, and Adadm J. Raines (Psychology, Virginia Tech)

MARILYN J. STEINBACH
VIRGINIA TECH / BIOLOGY
NICHOLE WHEELER
VIRGINIA TECH / CRIMINOLOGY
MORGAN LANE
VIRGINIA TECH / BIOLOGY
KELLY CORSANO
VIRGINIA TECH / PSYCHOLOGY
KYRA PARKER
VIRGINIA TECH / NEUROSCIENCE

Posttraumatic Stress Disorder Vulnerability in Women: The Neuropsychological Impact of Emotional Trauma from Rape

The current experiment aims to explore neurophysiological changes that result from rape. Given the preponderance of rape on college campuses, it is important for continued research efforts to provide insight into the impact that this traumatic experience may have on the victim in order to establish a foundation for prevention and treatment efforts. Based upon capacity theory, the current experiment will build upon prior research related to the capacity of specific brain regions to process and integrate the sensory and emotional demands of extreme stress. The aim of the experiment is to explore how the experience of rape results in similar brain dysfunction as that seen in individuals with other capacity limitations in the regulatory control of cynical hostility or denial and sympathetic advances of the ANS. It is hypothesized that women who have experienced rape will show decreased frontal regulatory control capacity compared to women who have not experienced rape with performance differences on well-established neuropsychological measures of left and right frontal lobe function. Furthermore, literature on the role of the right frontal region in regulatory sympathetic nervous system allows for advanced predictions of unbridled or poorly regulated sympathetic advance in these individuals having experienced rape-related trauma. This experiment uses behavioral measures (RFFT and COWAT) and a Cold Pressor test to stress the brain while recording blood pressure, EDA, and EEG.

Mentors: Dr. David Harrison and Benjamin B Devore (Psychology, Virginia Tech)

MORGAN C. STEPHENS
VIRGINIA TECH / BIOLOGY

Noncanonical NF-_B Signaling is Upregulated in IBD Patients and Contributes to Decreased Anti-TNF Treatment Response

Inflammatory Bowel Disease (IBD) is an umbrella term that is used to describe medical disorders involving chronic inflammation of the digestive tract including Crohn's Disease (CD) and Ulcerative Colitis (UC). Combined, CD and UC affect approximately 1.4 million Americans and over 4 million people worldwide. Current treatments for IBD including infliximab and adalimumab target tumor necrosis factor (TNF) to regulate inflammation. However, a large proportion of patients fail to respond to or eventually lose responsiveness to these agents. In this study we investigated the noncanonical NF-kB pathway and the role that this pathway plays in disease pathogenesis as well as infliximab response. Partnering with Carilion Clinic in Roanoke, VA, biopsy specimens from subjects with IBD (both CD and UC) as well as non-CD/UC patients were collected and categorized based on their responsiveness to treatments. These samples were then quantified and analyzed to identify dysregulated genes associated with NF-kB signaling. It was found that noncanonical NF-kB signaling is significantly upregulated in patients with IBD and has been shown to be associated with gastrointestinal inflammation. Additionally, a link between the noncanonical NF-kB signaling pathway and patients who are non-responsive to common anti-TNF therapeutics was established. These genes identified and the noncanonical pathway provide hopeful new targets for IBD therapeutics and treatments.

Mentor: Dr. Irving Coy Allen (BMVS, Virginia-Maryland College of Veterinary Medicine)

LYDIA STONEROOK
VIRGINIA TECH / HUMAN NUTRITION FOODS AND EXERCISE
ERIN SOWERS
VIRGINIA TECH / HUMAN NUTRITION FOODS AND EXERCISE
BROOKE SEATON
VIRGINIA TECH / BIOLOGY
ANNA SOFFIN
VIRGINIA TECH / BIOLOGY
BECKY VICK
VIRGINIA TECH / HUMAN NUTRITION FOODS AND EXERCISE

Anatomical Model of the Human Uterus

As students in the Curie and Da Vinci Science Living Learning Community, we collaborated on a semester-long project involving the creation of a laser-cut anatomical model. The goal of this project was to create a physical model that depicts the properties and functionality of the uterus during egg fertilization and menstruation. As part of this hands-on experience, we learned technical skills such as CAD Inventor and RHINO laser cutting software, and laser cutting technology. We used CAD to create an image of the uterus, which was then sent to a laser cutter to engrave the image into acrylic plates. We created two panels of the uterus, one showing the fertilized egg and one showing the unfertilized egg. This project challenged us to function as a team under stress, pressure and time constraints, while learning new concepts in the fields of science and technology. The finished model contains labels showing important physical components and arrows showing the progression of flow. We will present our laser-cut acrylic model and explain how these processes affect the human body.

Mentor: Lori Blanc (Biological Sciences, Curie and Da Vinci LLC, Virginia Tech)

LAUREN M. STRICKLAND
VIRGINIA TECH / BIOLOGICAL SCIENCES

The Effect of Various Symbiont Loads on Crayfish Behavior

Crayfish and their ectosymbiotic branchiobdellidan worms engage in a context dependent cleaning symbiosis that shifts between mutualism and parasitism based on the worm abundance. Previous research has shown that low to moderate worm abundances benefit the crayfish, whereas higher abundances lead to a weak parasitism. Most prior research on the context-dependent nature of this symbiosis has focused on the growth of the crayfish as the measure of the impact of the symbiosis. However, the effect of the worms goes beyond health and growth, affecting crayfish behavior. In light of this, we designed an experiment to determine how different symbiont loads affect general host behaviors through the mutualism/parasitism gradient. We used several behavioral assays commonly performed in crayfish research, including number of tail flips (which refers to an abdominal thrust that propels the crayfish through the water), distance traveled, time spent in active movement, and righting time (which measures the time it takes a crayfish to flip from their back to an upright position). Previous work led us to expect a unimodal response along the mutualism/parasitism gradient, with crayfish hosting a moderate number of worms performing the best. We achieved mixed results, with the response varying between assay used, as well as the sex of the crayfish. Our results have helped us further understand the relationship between this context dependent symbiosis and the health of the host crayfish.

Mentors: Bryan Brown, Bryan Brown, and Philip McElmurray (Biological Sciences, Virginia Tech)

ANNELISE M. STUNES
VIRGINIA TECH / BIOLOGICAL SCIENCES
TARYN R. SMITH
VIRGINIA TECH / BIOLOGICAL SCIENCES

DNA damage as a measure of environmental stress in animals

When cells divide, the chromosomes in the nucleus must be duplicated. Sometimes this division is not completed resulting in the formation of a micronucleus, a chromosome or chromosomal fragment that is not incorporated into one of the daughter nuclei. Micronuclei (MNi) have been proposed as a sign of genotoxic events and chromosomal instability. Since increased MNi levels are associated with DNA damage caused by cancer, radiation, toxins, trauma, and aging, the validity of MNi as a biomarker of genotoxicity in humans and mammals has been met with greater acceptance over the last few decades. We focused on improving the immunofluorescence technique for identifying MNi and extending the technique to use on red blood cells from birds. Immunostaining tests were performed on zebra finch blood smears fixed in formaldehyde. An increase in MNi visualization techniques and data collection on avian subjects provides information needed for future environmental and genetic toxicity studies, specifically biomonitoring. We are still modifying the technique to provide clear fluorescence imaging which we can apply to field studies of free-living birds.

Mentor: Dr. Ignacio Moore (Biological Sciences, Virginia Tech)

RHIANNON K. TAKEMOTO-JENNINGS
VIRGINIA TECH / PSYCHOLOGY

Pedestrian-Vehicle Communication at Crosswalks: Intervening to Increase the Rate of Pedestrian Gratitude

Undergraduate research assistants observed pedestrian-vehicle interactions at crosswalks by recording overt behavioral gratitude displayed by pedestrians. Throughout a three-phase process, a primary observer, a reliability observer, and a third observer with a tally counter collected these data. Data were collected for twelve consecutive weeks. After six weeks of collecting baseline data, an intervention was implemented on alternative weeks for three total weeks. For the intervention, a student held a poster at the crosswalk, which read, "Please Thank Drivers with a Wave." Subsequently, the poster was placed in the ground and not held by a student, and was alternated with baseline weekly for three total weeks. During all baseline periods, the average percentage of pedestrians displaying gratitude to the driver was 9.18%. The average percentage of pedestrians displaying gratitude when the poster prompt was held was 21%. When the poster was placed on the ground next to the crosswalk, an average of 11.16% of pedestrians displayed gratitude to the driver. This field study showed that a sign of gratitude from pedestrians to drivers is disproportionately low, but that a prompting intervention significantly increased occurrences of this desirable behavior.

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

COLLIN E. TANCHANCO OCAMPO
VIRGINIA TECH / BIOLOGICAL SCIENCES

Age-dependent effects on the peripheral immune transcriptome following traumatic brain injury

While age-at-injury influences chronic recovery from traumatic brain injury (TBI), the varying effects of age on early outcome remain unanswered. Our previous findings demonstrate an age-dependent neuroprotection in the juvenile brain following TBI. Disruption of the blood brain barrier allows peripheral immune cells to infiltrate and elicit inflammatory events. To test whether this protection is due, in part, to the differential response of the immune system we used next generation RNA sequencing analysis of peripheral blood from adult and juvenile mice. We observed 238 genes to be upregulated in juvenile peripheral immune cells while only 14 genes were upregulated in adult cells at 4 days post-cortical contusion impact (CCI) injury compared to sham controls. It was also observed that the injured juvenile immune cells showed increase gene expression related stress, proteolysis, metabolic process, and transport when compared to injured adult cells. Moreover, the juvenile cells showed reduced expression of genes involved in cell migration, cytokine signaling, inflammatory response compared to adult. These findings suggest that TBI induces differential gene response in the peripheral immune compartment that is age-dependent. This could have a significant impact on their migration to and functional response within the brain.

Mentor: Dr. Michelle Theus (Biomedical Sciences and Pathobiology, Virginia Tech)

JOANNE TANG
VIRGINIA TECH / MECHANICAL ENGINEERING

Echo Data Clustering

Bats have a unique biosonar system which relies on sophisticated structures for emission (noseleaves) and reception (ears) to achieve accurate echolocation capabilities. To reproduce these capabilities, a robotic sonar head has been built to mimic the echolocation system of a bat. The sonar head has been carried through a forest to collected a large set of echo data (~220,000). The objective of this project is to cluster the data based on differences in echoes that could reflect differences in the forest (i.e., tree species, different density of trees, areas with leaves vs without leaves, etc). Currently, the variational auto encoder (VAE) method is being utilized to cluster the data. The VAE is a deep learning approach to dimensional reduction. Each of the 220,000 data points (echoes) needs to be mapped into a low dimensional space (e.g,., 2 dimensions) in order to be classified into clusters. This is accomplished by the "encoder" portion of the VAE . The fidelity of this representation is being tested by using the "decoder" part of the VAE to convert the low-dimensional data representation back to the original input. Finding clusters or other regularities among the large and highly random echo data from natural vegetation will enable fast, reliable, and parsimonious navigation in natural environments, e.g., for drones that could be used for environmental monitoring or precision agriculture.

Mentor: Rolf Mueller (Mechanical Engineering, Virginia Tech)

SOPHIA D. TEXTORIS
VIRGINIA TECH / HUMAN DEVELOPMENT

Examining Sibling Experiences in Families of Individuals with Mental Illness

The purpose of this study is to review, summarize, and interpret the existing literature on siblings of individuals with mental illness (MI). Despite the prevalence of mental illness, little is known about how siblings are specifically affected in areas of psychosocial, emotional, and behavioral outcomes. The current study used a systematic review of the literature to identify all peer-reviewed studies that explore the sibling experience when a brother or sister has a diagnosis of MI. This will allow a better understanding of the challenges and benefits of MI in the sibling relationship, providing information to develop interventions and strategies to support healthy sibling interactions across the lifespan. The review yielded 51 quantitative studies that examined behavior problems, the sibling relationship, caregiving experiences, and other outcomes among siblings. The majority of studies from the initial search were focused on siblings-as-comparison group, examining siblings for risk factors for developing mental illness. Over half (N=29) of the included studies had samples primarily composed of siblings of individuals with schizophrenia, leaving more prevalent MI diagnoses such as depression, anxiety, and mood disorders underrepresented. However, results from comparison studies were mixed â€“ half found that the MI-Sibs were doing "better" than the comparison group, and half found that MI-Sibs were doing "worse."

Mentor: Dr. Carolyn Shivers (Human Development and Family Science, Virginia Tech)

DAVID C. THAMES
VIRGINIA TECH / COMPUTER SCIENCE
NOAH C. MILLER
VIRGINIA TECH / MECHANICAL ENGINEERING
QUAN T. NGUYEN
VIRGINIA TECH / COMPUTER SCIENCE

Workflow for Developing Virtual Reality Gestures Using Machine Learning

We propose a unique workflow for developing immersive virtual reality (VR) gestures, driven by machine learning. VR is becoming a more and more common technology, and interaction techniques need to evolve to fit this new medium. However, there is a lot of complexity in creating gestures with this many degrees of freedom while still maintaining the natural immersive feel that VR promises. Our system uses "Wizard of Oz" user studies combined with machine learning to crowd source the gesture definitions to match users natural intuitions. Users are put into a VR experience asked to perform an action in the experience, and based on the motions they make, a model is trained to treat those motions as a gesture for that action. Using this technique, we anticipate gestures will be designed to match users natural intuition while reducing the work the interaction designers have to do. The key research questions we seek to address are: Can high-quality gesture training data be obtained through simple gesture elicitation study data, can machine learning be used to define more intuitive gestures than traditional hard-coded gestures, and how does our machine learning gesture recognition system increase user satisfaction and immersion in the environment. Our preliminary results suggest a high testing accuracy for gesture recognition; however, more results are necessary to analyze how this impacts user immersion and satisfaction.

Mentors: Dr. Mike Horning and Dr. Doug Bowman (Computer Science, Virginia Tech)

CALEB W. THOMPSON
VIRGINIA TECH / MECHANICAL ENGINEERING
BLAKE FEICHTL
VIRGINIA TECH / COMPUTATIONAL MODELING & DATA ANALYTICS

Event Detection and Localization Using Machine Learning on a Staircase

Recent years have seen a push towards smart buildings that are energy efficient and proactive in decision making by detecting building events. Instrumentation of structures with sensors such as accelerometers or thermocouples is an essential element for providing the building with the necessary capabilities to enhance the occupant's comfort, safety and overall quality-of-life. One of the much-needed information about a building's activities is event localization. Event localization is a challenging task in an active environment as there is little control over the noise concurrent with the event. Determining ways to process sensor data efficiently and effectively will enhance the experience of the occupants. The present work pursues and evaluates an in-situ machine learning based approach for detecting and localizing footsteps on an instrumented staircase. The first part of the algorithm takes in live data from three accelerometers on a staircase and identifies footsteps based on a spike in the signal-to-noise ratio based on power spectral densities. The second part of the algorithm is the localization of the footstep once it is detected. Additionally, the performance of various features extracted from the time data (collected through controlled experiments) to generate an accurate machine learning model is also part of the current work. A nested tree algorithm is developed which yields 87% accuracy, showing potential for future stand-alone applications.

Mentor: Dr. Pablo Tarazaga (Mechanical Engineering, Virginia Tech)

ERICA S. TOWNSEND
VIRGINIA TECH / COGNITIVE & BEHAVIORAL NEUROSCIENCE

Adaptive Functioning and Depressive Symptoms in Minimally Verbal Children with ASD

This study investigated correlations between different types of adaptive functions and depression symptoms in minimally verbal children with ASD. Adaptive behaviors are known to be deteriorated in individuals with ASD (Frost, Hong, & Lord, 2017). Mental health issues including depression are prevalent in individuals with ASD as well (Kraper et al., 2017). A symptom of depression, anhedonia, decreases motivation and pleasure in even the simplest of activities (Feighner et al., 1994). It was hypothesized that consistent with previous literature, children with ASD with more depressive symptoms would show lower adaptive function (Frost et al., 2017). Participants included 15 minimally verbal children with ASD; one female and 14 males ranging from ages two to six. Measures included the Child Behavior Checklist (CBCL) to measure depressive symptoms (Achenback & Edelbrock, 1991) and the Vineland-3 to measure adaptive function (Sparrow, Cicchetti, & Saulnier, 2016), both reported by parents. Data were collected from children at a 2-hour intake appointment for a larger treatment study. Correlations were conducted between the affective problems subscale of the CBCL and four adaptive functioning subscales on the Vineland-3. No significant results were found, but there were consistent trends between declining adaptive functions and increasing depressive symptoms. Further exploration into these trends could help us better understand and treat the obstacles that these children face daily.

Mentors: Dr. Angela Scarpa and Ashley Muskett (Psychology, Virginia Tech)

BECKY Y. TRAN
VIRGINIA TECH / ANIMAL AND POULTRY SCIENCES

Effects of butyrate on nitrogen corrected apparent metabolizable energy of broiler chicks

Recently, there has been pressure to find alternatives that can replace or reduce the use of antibiotics in the poultry industry. Butyrate is a short-chain fatty acid that could promote the growth and proliferation of intestinal cells as a method to improve performance in the absence of feed antibiotics. The supplementation of a protected butyrate to growing broiler chicks should increase the intestinal health of broiler chickens resulting in an increase in nitrogen corrected Apparent Metabolizable Energy (AMEn). A control and protected butyrate diet were fed to Cobb 500 broiler chicks. Chicks were provided ad libitum access to experimental diets and water. Feed offered and refused was measured over the 16 day experimental period. Excreta samples were taken from excreta collected from 14 to 16 days. Excreta samples were analyzed for gross energy, nitrogen and titanium. Although there were no significant differences in body weight gain (P = 0.46) and mortality corrected feed conversion ratio (P = 0.70) between treatments, this was not unexpected as no challenge was provided to the birds and growing conditions were sanitary. However, the AMEn tended to be increased by 105 kcal/kg with butyrate in their diet compared to the control fed broilers (P = 0.10). Although not a direct replacement of antibiotics, it appears from the positive AMEn response that butyrate can be used to potentially promote intestinal health resulting in increased nutrient absorption of broiler chickens.

Mentor: Michael Persia (Animal and Poultry Science, Virginia Tech)

MATTHEW L. TRIBLE
VIRGINIA TECH / AGRICULTURAL TECHNOLOGY
BLAKE H. HAISLIP
VIRGINIA TECH / AGRICULTURAL TECHNOLOGY

Giles Land Lab Forage Improvement

The goal of our research project is to increase forage availability and quality at the Giles County Agricultural Land Lab in order to improve grazing and reduce the reliance on stored feeds. Soil samples were taken to determine where nutrient availability was limiting the growth of the forage and fertilizers were applied at the recommended rates to meet those nutrient needs. We also took forage samples determine the nutritive values of the forage that was available for the livestock. Weeds species were identified and appropriate pesticides were applied to control competition from weeds. Frost seeding of fescue, orchard grass, red clover, and white clover was implemented to increase available forage as well as quality. During our involvement with this project, we have seen the differences in pasture quality that spraying and reseeding have made. Results from our nutritive analysis indicate that forage quality is improving. Fields that were once hard to walk through are now lush pastures in the spring. The farm manager even states that he has had to start feeding hay much later than in previous years which is exactly what we are aiming to do with this project.

Mentors: Wes Gwaltney and Rachel D. Kohl (Agricultural Technology, Virginia Tech)

ROBERT S. TULLOSS
VIRGINIA TECH / AEROSPACE ENGINEERING

Computational Effort Reduction for Discontinuous Beam Analysis using Mixed-Dimensional Modelling

A model is developed for studying the stress concentrations in a cantilever, stepped beam. The beam has a rectangular cross-section with a fillet at the step and a tip applied axial load. The model is created using Abaqus/CAE 6.13, a commercially available finite element analysis software, and uses 3-dimensional (3-D) elements near the step with 1-D elements far from the step. The 1-D and 3-D elements are attached using kinematic coupling constraints at the transition. This makes the 1-D element the master node and forces the general displacements of the 3-D elements to be governed by those of the 1-D elements. The effect on the stress concentration factor is examined when varying 4 parameters: the proportion of the large beam modeled with 3-D elements, the proportion of the small beam modeled with 3-D elements, the fillet size as a proportion of the small beam side length, and the ratio of large to small beam side length. Controlling the results using dimensionless parameters ensures results are not specific to the dimensions and are valid for beams at various scales. The results showed large portions of the model could be represented using 1-D elements with only small errors in the stress concentration factor at the step.

Mentor: Rakesh Kapania (Aerospace and Ocean Engineering, Virginia Tech)

MORGEN VANDERGIESSEN
VIRGINIA TECH / BIOCHEMISTRY

Biological clocks and oxidative stress in Aedes aegypti Mosquitoes

Aedes aegypti mosquitoes are the primary vector of deadly viruses such as Zika and dengue fever and can transmit these viruses when blood-feeding. Every time they feed on a vertebrate host, female mosquitoes ingest large volumes of blood. Because of its iron content, blood induces oxidative stress to the mosquito, which can cause cellular damage. Mosquitoes have specialized mechanisms to relieve oxidative stress, which can be up-regulated in anticipation of blood-feeding at specific times of day, but opportunistic blood meals during atypical feeding times may cause higher physiological stress. Previous studies in the fruit fly Drosophila show that iron metabolism directly impacts the central biological clock and ultimately behavioral rhythms. However, there is little known about the relationship between the central biological clock and oxidative stress associated with blood ingestion by mosquitoes. In this project, we explore the impact of diet iron on behavior and gene expression using artificial feeding assays and molecular tools. Ultimately, this work will serve as a foundation for understanding the relationship between redox mechanisms and circadian rhythms in mosquitoes. This knowledge can be leveraged for further research to address vector-borne disease.

Mentor: Clement Vinauger (Biochemistry, Virginia Tech)

COURTNEY WALLS
VIRGINIA TECH / CROP AND SOIL SCIENCE, GENETICS AND BREEDING

Validation of Quantitative Trait Loci (QTL) Underlying Kunitz Trypsin Inhibitor in Soybean Seeds

Soybeans are typically roasted prior to inclusion in animal diets. It is important that the anti-nutritional factors (ANFs) components in soybeans are denatured prior to feeding them to monogastric animals, so that digestibility and animal performance are not reduced. However, during the heating process, beneficial amino acids are broken down and lost from the feed. The production of low trypsin inhibitor (TI) or TI- free soybean would not only increase the nutritional value of soybean but also save on costs of feed by reducing the energy of production. There is a critical need to develop improved, commercially viable soybean cultivars with low TI. In order to facility low TI soybean breeding, we have identified one major quantitative trait locus (QTL) (qKTI08) with a high LOD score of 24.95 on Chromosome 8 between positions 76.7 to 92.4 cM. The objective of this study was to validate this QTL using a population with different genetic background. The bi-parental population from V12-0198 (normal TI and RR2Y) x PI 547656 (low TI) was previously developed and grown in Blacksburg and Orange in 2016 and 2017. Five SNPs showing significant association with low TI within qKTI08 were converted into KASPar assays. Results show that SNP BARC_1.01_Gm08_44814503_C_T with a LOD score of 21.72 and accounting for 40.2% of the phenotypic variation can be used in marker-assisted selection (MAS) to incorporate the low KTI trait into breeding lines.

Mentors: Bo Zhang and Luciana Rosso (Crop and Soil Science, Virginia Tech)

YUEYING WANG
VIRGINIA TECH / BIOCHEMISTRY

Elucidating the Role of Membrane-Bound and Secreted Proteins in Fusobacterium nucleatum Virulence

Fusobacterium nucleatum is a gram-negative bacterium and one of the most common resident oral pathogens. It has been consistently implicated in the development of diseases such as periodontitis, preterm birth, and colorectal cancer. Virulence studies with intestinal cancer APCmin/- mouse models have characterized invasive F. nucleatum strains to target epithelial and endothelial cells to induce the inflammatory cytokine pathways seen in colorectal carcinogenesis. Despite consistently being implicated in disease, F. nucleatum lacks most of the major secretion systems (Types I, II, III, IV, VI, and IX) commonly utilized by gram-negative bacteria to achieve virulence and little is known of its molecular mechanisms. A combination of purification and functional studies of outer-membrane bound and secreted F. nucleatum proteins are currently being used to elucidate the details of these mechanisms. Five Type Vc secreted trimeric autotransporter genes have been discovered previously by the Slade Lab; the proteins which result from these genes have been denoted FvcA, FvcB, FvcC, FvcD, and FvcE. Successful purification of truncated forms of FvcD and FvcA have allowed us to pursue adhesion studies with these constructs. Additionally, preliminary purification data for a predicted phospholipase, FusoPortal gene 1882, has been collected in preparation for future studies. Through these studies, we hope to address several of the mechanisms behind F. nucleatum virulence.

Mentor: Daniel Slade (Biochemistry, Virginia Tech)

TAYLOR A. WARBURTON
VIRGINIA TECH / GEOSCIENCES

Spatial Mapping of Trace Element Concentrations in Well Water in Virginia

The U.S. Geological Survey reported in 2004 that more than 43 million people in the United States, approximately 15% of the population, rely on private wells for drinking water. Unlike public water systems, these private wells are not required to be routinely tested for water quality parameters under the Federal Safe Drinking Water Act, or even by state law. In Virginia, the Virginia Household Water Quality Program (VAHWQP), a Virginia Cooperative Extension program offered through Virginia Tech, provides information about maintaining and protecting private water systems, such as wells. Homeowners that choose to participate in VAHWQP's county-based drinking water clinics learn about their household water quality by submitting samples that are analyzed for a suite of water quality contaminants. Using datasets from the VAHWQP and the Virginia Department of Health (VDH), we are using ArcGIS Pro to conduct spatial mapping of well water concentrations of trace elements, including arsenic (As), manganese (Mn), nickel (Ni), vanadium (V) and chromium (Cr), among others, across Virginia. Many of these trace elements, when consumed at elevated concentrations, can have adverse health impacts for humans, so understanding their distribution in well water is important for public health. Results of the spatial mapping will be used to inform extension offices if there are regions of concern in Virginia where particular trace elements occur at concentrations above water quality guidelines.

Mentors: Madeline Schreiber (Geosciences, Virginia Tech), Tiffany VanDerwerker (Geosciences alum, Virginia Tech), Erin Ling, Brian Benham, and Asa Spiller (Biological Systems Engineering, Virginia Tech)

RACHAEL E. WARD
VIRGINIA TECH / EXPERIMENTAL NEUROSCIENCE

EphA4 is a novel mediator of blood-brain barrier breakdown following traumatic brain injury

Traumatic brain injury (TBI) is a prevalent injury that affects millions of individuals worldwide. This project focuses on the relationship between the blood brain barrier (BBB) permeability and the peripheral immune system with TBI recovery. Post TBI, breakdown and repair of the BBB plays a crucial role in brain recovery. Disruption of the BBB compromises the immune privileged brain, allowing unprivileged material, like peripheral immune cells to infiltrate exposed tissue. Immune cells are an analog for the extent to which the brain can be invaded or affected by the periphery. One receptor that is believed to play a role in BBB recover is EphA4, an endothelial cell membrane protein. Preliminary research indicates that EphA4 mediates BBB permeability and decreases the rate and ability of blood flow restoration. We want to characterize the change in BBB permeability associated with an increase EphA4 to explore its negative role in neuronal recovery by utilizing lab-generated wildtype and EphA4 knockout mice in a model of TBI. Each mouse received a moderate unilateral cortical impact and then sacrificed at two, 24 or 48 hours post-TBI. Their brains were then processed and sectioned for staining. Then they will be analyzed for immune infiltration and activation using antibodies against CD45 and CD68, respectively. We hypothesize that the EphA4 knockout mice will show reduced immune cell infiltration and BBB permeability which correlates with improved functional recovery.

Mentors: Michelle Theus (N/A, Virginia-Maryland College of Veterinary Medicine), Allison Cash (Theus Lab graduate student, Virginia Tech)

EVA WHALEY
VIRGINIA TECH / MATHEMATICS
DAVID GRIFFITH
VIRGINIA TECH / MATHEMATICS
ISAAC WILSON
VIRGINIA TECH / NANOSCIENCE
IAN HIGGINS
VIRGINIA TECH / STATISTICS

Creating a data-collecting rocket through collaborative learning

As part of the Curie and Da Vinci Science Living Learning Community experiential learning program, we built a rocket that flies straight up and collects data about its flight. We accomplished this by first acquiring technical skills in laser cutting, soldering, and other equipment and software available through a residential makerspace in Lee Hall. We then reviewed available literature to determine specific design aspects of the rocket. Specifically, we determined that using three fins would provide the rocket with the best amounts of stability and drag. We used coding skills to program an Arduino board to collect rocket flight data. We will present our rocket and associated flight data, and discuss our learning experiences.

Mentor: Lori Blanc (Biological Sciences, Curie & Da Vinci LLC, Virginia Tech)

JANAY A. WHITE
VIRGINIA TECH / BUSINESS INFORMATION TECHNOLOGY

Safety Concerns in Elderly Products

This presentation offers individuals a better understanding of elderly products and how safe they truly are. Many people do not realize how hazardous items are for their loved ones until they are the ones suffering from an unsafe purchase. My research consisted of going through thousands of reviews and identifying if a product was hazardous or not to seniors. The results were astonishing as many products that were meant to help keep the elderly safe were, in fact, endangering them. The hope is with this research we can bring light to the challenges seniors face and possibly come up with solutions. Many of these injuries could have been avoided if companies took more time and care into their products that they are selling to the elderly. The presentation takes thousands of Amazon reviews and separates them into several categories. What type of injury did the user suffer? What body part was affected? What was the potential injury if none was recorded?

Mentors: Alan Abrahams and David Goldberg and Nohel Zaman (Business, Virginia Tech)

WENDI E. WILLIAMS
VIRGINIA TECH / BIOCHEMISTRY

Can anaphase be simplified by bypassing separase?

Accurate chromosome segregation is crucial in cell division to ensure the proper passage of genetic information from mother to daughter cells. Improper sister chromatid separation during anaphase can result in aneuploid progeny cells, and eventual loss of cell viability. Proper sister chromatid separation requires the timely activation of the protease separase, which cleaves the cohesin ring that holds sister chromatids together. Separase targets the Rad21 subunit of the cohesin ring for cleavage. Prior to anaphase, separase is inhibited by a binding partner, securin. At anaphase onset, the Anaphase Promoting Complex (APC/C) initiates securin degradation, and active separase can then cleave Rad21. We aim to understand whether the requirement for separase in cohesin cleavage can be artificially bypassed by directly targeting Rad21 for degradation. Towards this objective, we attached the N-terminus of securin which comprises the "degradation box" to Rad21-GFP, and will monitor if Rad21 undergoes APC/C dependent degradation. The direct action of separase on Rad21 will be impeded by mutating the separase cleavage site on Rad21. These experiments help to address whether securin and separase become dispensable for chromosome segregation when Rad21 is directly targeted by the APC/C. The results will also provide insights into the exact role of separase in cell division, particularly whether separase has other functions in addition to cohesin cleavage.

Mentors: Silke Hauf (Biological Sciences, Virginia Tech), Drisya Vijayakumari (Postdoc, Virginia Tech)

KIMBERLY C. WINCK
VIRGINIA TECH / ANIMAL & POULTRY SCIENCES

Evaluating NLRX1 protection during Toxoplasma gondii (T. gondii) infection

Toxoplasma gondii is an intracellular parasite that can infect a variety of vertebrate hosts including domestic animals and humans. Transmission can occur through ingestion of contaminated food or drinking water or transplacental from the pregnant mother to the fetus. The purpose of this experiment was to evaluate the role of NLRX1 during T. gondii infection. Mice both with and without NLRX1 were infected with 1,000 T. gondii tachyzoites and monitored daily. Clinical scores were graded on a scale of 0-4 and derived from individual assessments of coat condition, breathing assessment, activity level, behavior, and percent weight loss. At euthanasia, the liver, brain, and spleen were harvested for histopathology assessments, whole blood was collected for serum extraction, and RNA was extracted from a portion of the spleen. We hypothesize that NLRX1 attenuates T. gondii infection, and expected mice lacking NLRX1 would experience greater disease severity compared to age and gender-matched WT mice. Though all animals displayed infection detected by clinical score at the same time, we anticipate that downstream measurement of disease severity will correlate with NLRX1 protection. We will evaluate the severity by tissue lesion severity assessed by histopathology and measurement of pro-inflammatory mediators quantified by ELISA and qRT-PCR. A clearer understanding of the role of NLRX1 in T. gondii infection would provide insight for potential future treatments of infection.

Mentors: Dr. Irving Coy Allen (Biomedical Sciences & Pathobiology, Virginia-Maryland College of Veterinary Medicine), Dr. Veronica M. Ringel-Scaia (Graduate Program in Translational Biology, Medicine, and Health, Virginia Tech)

OLIVIA A. WISNEWSKI
VIRGINIA TECH / HISTORY

Recovering Vets of WW1: Research in the Archives

This project was a concentrated effort to find information on Veterans from Virginia Tech who fought and died in World War 1. This past semester's research was specifically about men who died in France or went MIA during the war. This study was done as a part of a larger project through which Virginia Tech is trying to honor the men who fought overseas in the first World War. During the fall semester of 2018, researcher Wisnewski used family databases such as Ancestry to trace the men on a list provided to her by Dr. Becker. She looked for records of service, family history, and records of what happened to these men after the war. The information collected by researcher Wisnewski will go towards the updating of the Virginia Tech Omeka website about the men of WW1.

Mentor: Trudy Harrington Becker (History, Virginia Tech)

MITCHELL V. WOODHOUSE
VIRGINIA TECH / BIOLOGICAL SYSTEMS ENGINEERING

An Investigative Comparison Of Current Climate Services

The 20th century was documented as the warmest period in modern human history. Current evidence concludes with high confidence that this warming trend, and changing climate, is the result of human activities, including the emissions of greenhouse gasses. Climate changes are expected to continue throughout the 21st century and have the potential to change the lifestyle of affected communities and individuals. The scope and intensity of these changes is difficult to predict, complicating the processes of adapting to the climate and mitigating the scale of further climate change. In an effort to improve the quality of life for affected individuals and minimize the cost of climate related damages, various organizations are currently searching for methods of determining the most resistant to climate change (robust) adaption and mitigation pathways. Climate services, developed as extensions of climate models, are a powerful tool and have been used to assist with robust decision analysis by providing predictions tailored to specific decisions. However, when presented with various climate services, how do individuals, communities, and organizations know which climate service will offer them the most robust solution to a specific climate problem? This report aims to investigate differences between publicly available climate services and devise a method of comparison between existing services.

Mentors: Dr. Julie Shortridge and Julia Reis (Biological Systems Engineering, Virginia Tech)

ELEANORE WOODRUFF
VIRGINIA TECH / BIOLOGICAL SCIENCES
KATHERINE ORLOWSKY
VIRGINIA TECH / EXPLORING LIFE SCIENCES
KELLY WINKLEPLECK
VIRGINIA TECH / CROP AND SOIL ENVIRONMENTAL SCIENCE
KRISSY PIECZYNSKI
VIRGINIA TECH / ENVIRONMENTAL HORTICULTURE
MATEO MAUGHLIN
VIRGINIA TECH / HUMAN, NUTRITION, FOODS, AND EXERCISE
WILLIEM GRABNER
VIRGINIA TECH / NEUROSCIENCE

Developing a Portable Solar Panel Charger as a Common-Interest Community Team

The goal of this project is to develop a practical, compact solar panel USB charger, as part of the Curie and Da Vinci Living Learning Community First Year Experience. This hands-on project helps students develop collaboration and communication skills while they find solutions to time management issues and resource disparities. This experience provides students a low-risk environment to work with others from various scientific backgrounds and develop technical skills such as laser cutting and soldering. Our team members used Clifton Strengths to determine our strengths, and used this information to inform group discussions and work sessions. Project development involved soldering a charger, designing a laser cut wooden case using Rhino CAD software, and fitting the charging mechanism into it the case. We will present the design and construction process, demonstrate the functionality of our completed solar charger, and discuss challenges experienced during our learning process.

Mentor: Lori Blanc (Biological Sciences, Curie and Da Vinci LLC, Virginia Tech)

ALLISON WOODS
VIRGINIA TECH / COMPUTATIONAL MODELING AND DATA ANALYTICS
ADAM PRYS
VIRGINIA TECH / APPLIED DISCRETE MATHEMATICS
KATLYN MORALES
VIRGINIA TECH / NANOMEDICINE
KYLE HART
VIRGINIA TECH / COMPUTATIONAL MODELING AND DATA ANALYTICS

The Development of Project Ozone: A Rocket

As students in the Curie Living Learning Community, we completed a collaborative project that involved designing, building and launching a rocket. In addition, we sought to gain a better understanding of how the rocket worked in relation to our predictions by analyzing the results of a rocket launch. During the conceptualization and analytical phases, we used OpenRocket, C++, and data analysis and visualization techniques. During the build phase, we developed technical skills through the use of laser cutting and soldering. We used C++ to program an Arduino to collect data on our rocket launch, and OpenRocket software to simulate the best outcomes of our launch. After developing and testing a virtual design using OpenRocket, we constructed the rocket and prepared it for launch. We will compare real-world data collection to our simulated results, and discuss our experiences with the project and the analysis of our data. The entirety of the project allowed for the practice of oral, visual and written communication skills in both formal and informal contexts. The intent of conducting this project was to create opportunities that lead to problem-solving and communication progression. Working on this project allowed us to develop better technical skills, as well as team and communication skills.

Mentor: Lori Blanc (Biological Sciences, Curie & Da Vinci LLC, Virginia Tech)

ABIGAIL W. WORKMEISTER
VIRGINIA TECH / BIOCHEMISTRY

Nutritional iron as a sole variable for circadian clock resetting in liver cells

As diets vary substantially in their composition efforts focused in identifying specific nutrients that can act as clock zeitgebers. Food macronutrients such as resveratrol, procanthocyanidins, carbohydrates, and polyamines act in the clock either indirectly, by acting in a signaling pathway that eventually influence the activity of circadian proteins, or directly, by targeting a specific core clock component. On the other hand, only a limited number of micronutrients (e.g., some vitamins) and natural ligands (e.g., cholesterol, eicosanoids, and retinoic acid) are known to directly target clock molecules. A case-point in our study refers to iron as an essential micronutrient for which maintaining its homeostasis is relevant to the entrainment of the hepatic clock. As today, mounting evidence establishes dietary iron modulates circadian rhythms of hepatic function through AMPK and SIRT1 metabolic sensors; however, a void exists with regards to whether iron could circumvent this peripheral pathways and directly influence the expression and/or activity of clock components to promote resetting. Accordingly, our work establishes that iron overload directly impacts circadian oscillation by acting on the expression and stability of its core clock components, a result that favors the existence of a regulatory loop in which circadian regulatory components modulate and are being influenced by the metabolic iron pool.

Mentor: Carla Finkielstein (Biological Sciences (Biocomplexity Institute), Virginia Tech)

ERIC D. WUERFEL
VIRGINIA TECH / PHYSICS

ChirpLAB: Alternative Filtering Methods in Gravitational Wave Astronomy

Since 2016, the LIGO Scientific Collaboration (LSC) has successfully observed gravitational waves from several Binary Black Hole mergers and one Binary Neutron Star merger. Due to the sensitivity of interferometers, scientists at the LSC use the matched filtering process to observe gravitational wave signals. The matched filtering process is computationally expensive, and relies on the generation of over 100,000 complex template waveforms. These templates can take months to produce, even on CalTech's best computing clusters. These templates also rely on assumptions about the source that produces the observed signal, and the accuracy of General Relativity. ChirpLAB is a library of MATLAB routines, developed to detect "chirping" signals (signals whose frequency increases over time). Gravitational waves from binary mergers fall into this chirping signals class. By simulating gravitational wave signals, I've confirmed ChirpLAB's ability to detect chirping signals in noise characteristic of interferometers. ChirpLAB also has the remarkable ability to detect superimposed gravitational wave signals from binary mergers, and independently resolve the times of coalescence. After confirming ChirpLAB's efficacy in gravitational wave detection, I have been working with Heta, who is a grad student on my team, to alter ChirpLAB to read data from the LIGO Open Science Center using the ARC's Cascades Computing Cluster.

Mentor: Lydia Patton (Philosophy, Virginia Tech)

BRIAN K. YOON
VIRGINIA TECH / BIOLOGY

Predicting Baseline Physiological Trait Values for Data Deficient Species Using Evolutionary Models

Important physiological trait data is missing or inadequate for a large portion of species across the tree of life. This project aims to fill in these gaps using a predictive evolutionary model, utilizing previously accumulated data as reference points. These reference points were obtained from a large trait database of normal animal reference values across 86 physiologically important blood chemistry tests and other physiological measurements. We used a Brownian Motion model to predict values for missing species using the phylogenetic tree. To evaluate how well our model performed, we conducted a cross validation study to determine the accuracy of the model for each trait. Results showed several traits that were highly predictable due to their phylogenetically-conserved nature, while other's traits yielded predictions that were distant from their actual values and indicate very little phylogenetic signal for these traits. For some traits, we find evidence of poor predictions in certain groups of organisms, indicating that the evolutionary process has changed in these groups. Other predictions suggest errors in the database. Our analysis helps determine which traits are evolutionarily predictable, and which were too noisy to confidently predict. Continued refinement of the model is in order to enable practical use of species trait predictions, as well as possible medical and veterinary usage for poorly studied and understood species.

Mentor: Josef Uyeda (Biological Sciences, Virginia Tech)