VirginiaTech
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Summer Research Symposium

July 31, 2014 Graduate Life Center

http://www.research.undergraduate.vt.edu

The Summer Undergraduate Research Conference is a highpoint of our summer at Virginia Tech. Most students presenting today have spent ten or more weeks immersed in a research project full-time. Summer affords undergraduates the opportunities to dedicate significant time and effort to the planning, execution and analysis of a research project. They have also had the chance to become authentics member of research teams by working side-by-side with faculty, graduate students, postdoctoral fellows and research staff. Many thanks to all who have mentored undergraduates this summer. Virginia Tech is pleased to offer these summer experience not only to our own students, but also to undergraduates from all over the country. We hope that you have enjoyed your time at Virginia Tech, and we appreciate the diversity of ideas and cultures that you have brought to our campus. Congratulations to all of our presenters!

A very special thank you to Keri Swaby and Anita Dodson for their tremendous work in making this symposium happen!

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

Thank you to our sponsors!

Virginia Tech Office of Undergraduate Research

Virginia Tech Office of Undergraduate Studies

Multicultural Academic Opportunities Program

HHMI Scieneering Program

Fralin Life Sciences Institute

Special Thanks to you!

Program Directors:

Biomechanics- Dr. Pam VandeVord (Biomedical Engineering)

Bioprocess Engineering for Sustainability- Dr. Justin Barone (Biological Systems Engineering)

CenTire- Dr. Saied Taheri

Cognitive Communication- Dr. Carl Dietrich (Electrical and Computer Engineering)

Hands-On, Minds-On- Dr. Cindy Smith (Human Development)

Interdisciplinary Water Science and Engineering- Dr. Vinod Lohani (Engineering Education)

MAOP- Dr. Jody Thompson-Marshall (MAOP)

Microbiology in Post Genome Era- Dr. Biswarup Mukhopadyay (Biochemistry)

Scieneering- Keri Swaby (Office of Undergraduate Research)

Space@VT- Debbie Collins, Robert Clauer, Scott Bailey

StREAM- Dr. Leigh Ann Krometis and Dr. Cully Hession (Biological Systems Engineering)

SURF- Keri Swaby (Office of Undergraduate Research)

TOUR- Dr. Deborah Good (Human Nutrition Foods and Exercise)

VBI- Betsy Williams (VBI)

VTTI/TURF- Gabrielle Laskey and Cecilia Elpy

Undergraduate Peer Mentors:

Letitia Clay (Biological Sciences) Scieneering summer research (2013)

Dorian Jackson (Biological Sciences) Fralin SURF (2013)

Alex Karikari (Mechanical Engineering) Scieneering summer research (2013)

Kumiko Lippold (Psychology) Scieneering academic year research (Fall, 2013)

Carrie Hughes (Chemistry and Biochemistry) May 2015

Event Coordinator:

Anita Dodson- Office of Undergraduate Education

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Keynote Address:
Patricia M. Dove, Department of Geosciences

Biography:

Dr. Patricia Dove is a 2013 recipient of the MSA Dana Medal, Fellow of the Geochemical Society and European Association of Geochemistry, and Fellow of the American Geophysical Union for her contributions to biological mineralization and the biogeosciences. She is also the recipient of an Undergraduate Teaching Excellence Award, the F.W. Clarke Medal, and is twice recognized by Best University Research Awards from the US Department of Energy. In 2012, Trish was elected to the National Academy of Science.

"Shelling Out The Shapes"

Over the last 500 million years, animals have developed the ability to synthesize the functional materials that we know as shells, teeth, bones, and more! These biominerals[1] are complex organic-inorganic composites that often exhibit exquisite morphological complexity and possess remarkable physical properties. Using principles from chemistry, biology and materials physics, Professor Dove and her students are conducting interdisciplinary studies of chemical controls on patterns of biomineralization. This presentation will introduce the amazing world of biominerals and highlight recent efforts by the Dove group to decipher the processes by which modern and ancient produce these structures.

SCHEDULE AT A GLANCE

7:30-8:00 Registration and Poster set up in multipurpose room

8:00-8:15 Opening Remarks in the auditorium

8:30-9:30 Poster Session 1-Multipurpose room

9:45-11:30
Oral Session I-Room A
Oral Session I-Room B
Oral Session I-Room C
Oral Session I- Room D
Oral Session I- Room F1 and F2
Oral Session I- Room G

11:30-12:30 Keynote Speaker Trish Dove-Auditorium

12:30-1:30 Lunch-Graduate lounge

1:30-2:30 Poster Session II-Multipurpose room

2:45-4:45
Oral Session II-Room A
Oral Session II-Room B
Oral Session II- Room C
Oral Session II- Room D
Oral Session II- Room F1 & F2
Oral Session II- Room G

4:00-5:00 Poster Session III- Multipurpose room

ACC Creativity and Innovation Scholars

Program Description: This program funded by the Inter-Institutional Academic Collaborative of the Atlantic Coast Conference (ACCIAC) supports current Virginia Tech undergraduate students who are involved in independent research projects or creative works under the mentorship of faculty. Selected Virginia Tech scholars receive a monetary award that can be used as a stipend and/or direct support of expenses such as supplies, travel, and use of specialized research services. Students from all academic disciplines were eligible to apply to the program. The six selected students represent four of the seven undergraduate colleges at Virginia Tech.

Program Director: Dr. Jill Sible, Office of Undergraduate Studies

Matthew Chernick

Devon Johnson

David Mackanic

Angela Serna-Geitz

Nicholas Tibbetts

Shelbie Turner

Bioprocess Engineering for Sustainability NSF-REU

Program description: Bioprocess engineering is an engineering discipline that utilizes biological materials and methods to make fuels, chemicals, plastics, and pharmaceuticals. Bioprocess engineering is a rapidly growing field that applies green engineering principles to replace current fossil fuel based processes. Research areas include synthetic biology and metabolic/ genetic engineering for biofuel and biochemical production, protein engineering for biopharmaceuticals, and sustainable biomaterials.

Program director: Dr. Justin Barone, Biological Systems Engineering

Celeste Blum

Vincent Encinas

Simone Gelinas

Nathan Harms

Ben Heithoff

Will Heydinger

Victoria Morales

Jasmine Naik

Jen Paul

David Roth

Shannen Scott

Jessica Symons

Kids Tech University
Bridging the gap between physics, computer science, and K-12 education (VBI)

Program Description: Funded by an NSF grant, this 10-week summer undergraduate training opportunity was centered around bridging the gap between physics, computer science, and K-12 education. During the summer program, 2 undergraduate students (one majoring in physics and another in education) worked together to produce various online content (including analyzing and exploring synthetic circuits that could be used to guide the decision of a dividing cell culture) that will be used in primary schools and on the Kids' Tech University website. A teacher manual and hand-outs were also produced.

Program Coordinator: Betsy Williams (VBI)

Kids' Tech Physics

Adam Mills

Lilian Hummer

MBI/Ohio State and VBI/VT

Madeline Edwards

Akira Horiguchi

Cognitive Communications NSF REU

Program Description: Students participate in research activities in the field of Cognitive Communications through the NSF Research Experiences for Undergraduates (REU) program. REU participants will work on research projects related to software-defined radio (SDR), cognitive radio, and other aspects of wireless communications.

Program Director: Dr. Carl Dietrich, Principal Investigator and REU site director (Electrical and Computer Engineering)

Logan Woodcock
Akshay Iyer
Ethel Baber
Danielle Ho
Thomas George Vormittag
Elizabeth Cole
Ian Ho
Edward Powell
Frank Lykes Claytor
Boubacar Abdou Tchoussou

Research Experiences for Undergraduates in
Cognitive Communications

Fralin Life Science Institute Summer Undergraduate Research Fellowship (SURF)

Program Description: The Fralin SURF program is a 10-week training program designed to give motivated undergraduates the opportunity to engage in full time (approx. 40 hrs/wk) research and related professional development activities that mirror graduate training. The goal is to offer students experiences that will help them determine if they want to pursue a career in research while they develop skills for graduate school. The program includes weekly research and professional development seminars, periodic social events, and a final symposium during which students will present their research.

Program Director: Keri Swaby, VT Office of Undergraduate Research

Whitney H. Beasley
Samuel Berk
Hayley E. Billingsley
Benjamin C Coleman
Keith K (Karl) Compton
Elizabeth A P Denson
Jiale Du
Alana M Dudek
Cynthia M. Guerin
Justin F Hall
James Hampton
Michael K Jones
Zachary W Kemp
Michelle (Mi Song) Kim
Wonjae P Kim
Ki E Lee
Holly E Packard
Grace A. Parker
Kaitlyn M Phillips
Morgan E Simpson
Caroline J Stephenson
Austin A Tatum
Hannah K Toutkoushian
Leigh A Vogelbein
Thomas A Wood
Diana Woodrum
Courtney E. Youngbar
Shelton Roosevelt Boyd
Mahtaab Bagherzadeh
Valentina Alaasam
Kevin Potts

"Hands-On, Minds-On": Multidisciplinary Approaches to Understanding and Preventing Societal Violence NSF REU

Program description: The "Hands-On, Minds-On" research experience for undergraduates (REU) brings together faculty and staff from a variety of different disciplines, departments, and offices at Virginia Tech. Ten students will be selected from national four-year colleges and universities and within the Virginia Community College System to participate in a 10-week National Science Foundation (NSF) Research Experience for Undergraduates Program.

Program Director: Dr. Cindy Smith, Human Development

Program Coordinator: Robert Jacks, College of Liberal Arts and Human Sciences

Katya Davydova

Georgiana Lee

Alvin Taylor

Bradi Heaberlin

Elizabeth Hanley

Autumn Nicely

Hadley Brochu

Miriam Clayton

Maria Haas

HHMI Scieneering Program

Program description: Building on VT's strengths in science and en- gineering, the Division of Undergraduate Education, through funding from a prestigious HHMI Science Education Grant, offers a novel and innovative program focused on interdisciplinary undergraduate stud- ies and research, aptly named Scieneering. Science and engineering sophomores and juniors selected to become Scieneers will participate in coursework leading to minors in Interdisciplinary Engineering and Science or Science, Engineering and Law and conduct at least 3 credit-hours of interdisciplinary research mentored by faculty outside their major discipline. This is a great opportunity for students to gain experience tackling real-world, multi-dimensional problems under the direction of a qualified mentor. Scieneers receive a stipend and funds to purchase supplies pertinent to their selected research project.

PI and co-PIs: Dr. Jill Sible, Dr. Bevlee Watford, Dr. Kristi DeCourcy

Program Manager: Keri Swaby, Office of Undergraduate Research

Education Undergraduate Peer Mentors: Letitia Clay, Kumiko Lippold, Alex Karikari, Dorian Jackson

Andrew Anklowitz
Anthony Berlenbach
Rebecca Engler
JaymeLee Ewing
Priya Ganesh
Robyn Goad
Michael Harring
Jonathon Howarth
Kimberly Hughes
Ashkan Katirai
Rachel Ladenburger
Lily Lewis
Thuy Nguyen
Jay Pandya
Seonghoon Park
Juliette Parks
Alexandra Patterson
Alejandro Perilla
Matthew Razaire
Andrew Restaino
Tony Rizk
Kent Robinson
Chris Rubel
Rachel Stein
Hannah Mae Tecson
Leejoo Wi
Caitlin Wilkinson

Interdisciplinary Water Sciences and Engineering NSF REU

Program Description: This NSF-REU Site on Interdisciplinary Water Sciences and Engineering at Virginia Tech was established in 2007. Two cycles (2007-09) and (2011-13) of this Site have been completed and 56 excellent undergraduate researchers (33 women + 23 men) (REU fellows) representing 45 different institutions in the United States have graduated thus far. This summer this Site is hosting 11 excellent REU fellows. Faculty members and their graduate students from a variety of disciplines including Engineering Education, Civil and Environmental Engineering, Geosciences, Biological Sciences, Industrial Design, and Crop and Soil Environmental Sciences mentor REU fellows to conduct research on various interdisciplinary aspects of water sciences and engineering. The REU fellows get opportunities to conduct independent research and improve their communication (written and verbal) skills. Field trips and weekly seminars are organized to develop professional skills. Weekly social interactions are facilitated to enhance personal and professional bonding among REU fellows and with faculty/graduate students. At the end of third cycle in 2016, this Site would have graduated 86 REU fellows.

Site Director: Dr. Vinod K Lohani (Engineering Education)

Faculty Mentors (Summer 2014): Drs. Marc Edwards, Amy Pruden, Andrea Dietrich, Erich Hester, Randy Dymond, Jennifer Irish, Cayelan Carey, Maddy Schreiber, Robert Weiss, Kang Xia, Akshay Sharma, Brook Kennedy, Vinod K Lohani

Graduate Student Mentors (Summer 2014): Terri Sosienski, Alex Gerling, Zack Munger, Stephanie Smallegan, Daniel Brogan, Walter Mcdonald, Debarati Basu, Hari Raamanathan, Rebekah Hupp, Cheng Wei, Katherine Phetxumphou, Jon Doubek, Breeyn Greer

Kara Harrison

James von Dollen

Mariah Redmond

Savannah Cranford

Lauren Wind

John Purviance

Jamie Keyes

Melissa Wilson

Steven Keith

Mariah Haberman

William Scally

Microbiology in a Post Genome Era

Program description:A 10-week summer research training program for undergraduates that focuses on a wide range of microbiological phenomena. The program integrates the application of state-of-the-art genome-based technologies for fundamental and applied research projects in microbiology

Program Director: Dr. Biswarup Mukhopadyay (Biochemistry)

Amanda Freiborg

Leslie Sepaniac

Mariah Smith

Ashley Thornhill

Adam J. Kleinman

Lizette I. Carrasco

Melissa Dobson

Dajah Swinton

Mazoe Morris

Multicultural Academic Opportunities Program (MAOP)

Program Description: MAOP is an academic success community founded upon the principles of self-help, mentoring and peer support. Central to the goal of MAOP is the promotion of diversification in the student body at Virginia Tech and on the post graduate level-particularly in the science, math, and technology areas. The summer research internship is a 10-week research experience where students work with a faculty member in a mentor/protégé relationship to design, conduct and present a scholarly research paper. Students learn to plan and conduct research in their field of interest, attend seminars, participate in field trips, use state-of-the-art equipment, prepare for the GRE, and attend a two and a half day exploratory retreat.

Program Director: Dr. Jody Thompson-Marshall
Assistant Director: Lauren Harris

Kevin Arnold
Emily Blair
Naomi Butler-Abisrror
Durga Dahal
Crystal Davis
Diego De La Torre Campos
Frank DeBenedictis
Kathryn Dunn
Solmaz Eskandarinezhad
Iriat Faisal
Floricel Gonzalez
Carolyn Greene
Brandon Gulledge
Abbey Hammell
Chelsea Horton
Gisella Kakoti
Josef Mang
Tiara McDonald
Alex Newman
Christopher Owusu-Sampah
Bishal Paudel
Diana Pham
Juliana Pham
Christian Reina
Cedric Revell
Alexandria Robinson
Alexander Shimozono
Michael Sibilo

A Multiscale Approach to Biomechanics NSF REU

Program Description: This REU program allows students to experience a multi-scale approach to biomechanical research. Students were fully integrated into participating research groups and experienced hands-on lab research, group meetings, and close collaboration with other members of related research groups. By conclusion of the program, students should understand the connection between biomechanical research and fundamental biological processes in health, injury, and disease.

Program Director: Dr. Pamela VandeVord, Biomedical Engineering

Alexandra Gobeler

Casey Patnode

Jacquiline Plyler

Lauren Severance

Evan Terrell

Keegan Yates

Stacie Zwolski

John Brady

Kevin Joseph

Whitney Tatem

Paige Szymanski

Space@VT NSF REU

Program Description: The Center for Space Science and Engineering Research (Space@VT) resides in the Virginia Tech College of Engineering (CoE) with members from the Bradley Department of Electrical and Computer Engineering and the Aerospace and Ocean Engineering Department. Space@VT faculty lead research in both ground based, and satellite based measurements of the upper atmosphere and space weather phenomena, as well as theoretical and modeling research into space plasmas. The REU site exposes students to these various research programs and enables students to select a specific project for detailed focus. We provide undergraduate students an engaging high-quality learning experience over a period of 10 weeks. The program will elevates the students' exposure to space weather and plasma research, while preparing them for positions in academia, industry and government. We recruit talented, motivated and diverse students, and provide them education and orientation with a series of readings, seminars, laboratory work, community-based outreach, and social and professional development activities.

Program Directors: Dr. Robert Clauer, Dr. Scott Bailey (Electrical and Computer Engineering)

Program Coordinator: Padma Carstens

Magdalina Louise Moses

Susannah Grace Darling

Sean Joseph Babcock

Daumier Jomar Maldonado

Anthony Thomas Wolosik

Riley William St. Pierre

Amanda Dawn Friedrichs

Caroline Marie McElhenny

Joel Buttars

James Clouse

Dynamics of Water and Societal Systems: An Interdisciplinary Research Program at the Virginia Tech StREAM Lab NSF REU

Program Description: The StREAM Lab REU represents a true integration across numerous disciplines, with participating faculty members from ten different departments and five colleges at Virginia Tech. An extensive array of real-time spatio-temporal monitors at this site permits students to investigate complex, systems-level interactions within a relatively small, manageable watershed.

Program Directors: Dr. Cully Hession and Dr. Leigh-Anne Krometis (Biological Systems Engineering)

Graduate student lead mentor/coordinator: Heather Govenor

Karla Boza

Nicole Carter

Erica Davis

Cort Hammond

Christine Hart

Caleb Higginbotham

Sarah Medley

Andrea Stewart

Tire and Automotive Engineering (CenTire) NSF REU

Program description: Virginia Tech's Center for Tire Research offers summer undergraduate researchers the opportunity to participate in a broad range of research topics including: Design and Fabrication of a Bevameter, Design and Fabrication of a Shear Box, Portable Road Profiling System, ABS Validation, Tire Testing Trailer, Quarter-Car Suspension Test Rig, Piezoelectric Based Energy Harvesting towards a Smart Tire, BASE Suspension Testing, and Real Time Robotic Driver System.

Program director: Dr. Saied Taheri, Center for Tire Research

Afton White

Austin Dexter

Brent Cox

Eric Pierce

Kevin Engleson

Mei Bandy

Michael Ng

Robert Stevens

Ryan Knights

Samuel McFalls

Translational Obesity Undergraduate Research Scholars Program

Program Description: The Translational Obesity Undergraduate Research Scholars (TOUR-Scholars), under the umbrella of the Fralin Translational Obesity Center (Fralin-TORC) and its Interdisciplinary Graduate Education Program (IGEP), is a research-intensive summer experience, which prepares students for graduate and medical education in translation obesity research. Five undergraduate students from departments across Virginia Tech, along with one student from the State University of New York, College at Fredonia, were chosen to participate in the 2014 summer program.

TOUR-Scholars were matched in a translational project with two faculty mentors, working across disciplines. Funding was obtained through faculty-mentor matching of funds, the Department of Human Nutrition, Foods, and Exercise, the College of Agriculture as well as contributions from the Fralin Translational Obesity Research Center, to provide a research stipend for each of the students, and some discretionary funds.

Program Director: Dr. Deborah Good (Department of Human Nutrition, Foods, and Exercise)

Maya Mills

Annie Ickes

Justin Resendes

Sea-On Lee

James Foley

Caitlyn Hill

Transportation Undergraduate Research Fellowship (TURF) Program

Program Description: The Transportation Undergraduate Research Fellowship, or T.U.R.F., program is in its first year and is designed specifically to educate future Engineers, Computer Scientists and Psychologists who want to work in the field of transportation research. T.U.R.F. is funded by the Connected Vehicles-Infrastructure University Transportation Center (CVI-UTC) which is one of sixteen research centers in the Virginia Tech Transportation Institute (VTTI). The CVI-UTC is made possible by a grant from the Research and Innovative Technology Administration at the U.S. DOT, and a consortium partnership between Virginia Tech, the Virginia Department of Transportation, the University of Virginia, and Morgan State University in Baltimore, MD.

Program coordinators: Gabrielle Laskey, Cecilia Elpy

Kayla Sykes

Annabel St. Louis

Poster Session I
8:00 am- 9:30am

1. Kevin Arnold

Analysis of the membrane binding properties of INPP4B

Inositol polyphosphate phosphatase 4 B (INPP4B) is a recently discovered protein that has tumor suppressor properties. Using its catalytic domain, INPP4B dephosphorylates the four position phosphate on the inositol ring of phosphatidylinositol 3, 4-bisphosphate (PtdIns(3,4)P2) as part of the PI3K pathway. If left phosphorylated, PtdIns(3,4)P2 will activate the Akt causing cell growth, motility, and proliferation which left unrestricted leads to tumor formation. Studies found the PI3K/Akt pathway is defective in many human cancers. Furthermore, it has been found that INPP4B is missing or defective in 84% of human breast cancers. The purpose of this study was to examine both the ability of INPP4B and its C2 domain to bind phospholipids. While it is possible use bacteria to overexpress the full length protein, as evidenced by previous studies, some difficulties were encountered. Cultures of E. coli (Rosetta strain) were induced at different experimental conditions without success. Instead a different strain, BL21, was used for the full length INPP4B. Its C2 domain was successfully purified and its membrane binding was tested using the lipid protein overlay assay. The results showed that the protein strongly binds to PtdIns(4,5)P2 and weakly to phosphatidic acid (PA). This differed from previous studies which showed strong binding to PA and PtdIns(3,4,5)P3 and weak binding to other phosphoinositides. This result suggests that INPP4B anchors the plasma membrane through PtdIns(4,5)P2 and allows the protein to precisely catalyze the dephosphorylation of PtdIns(3,4)P2 via its catalytic domain. Understanding how INPP4B binds to the membrane and how that affects its function allows for a better understand of cancer and creates the potential for new treatments.

Mentor(s): Dr. Daniel Capelluto

2. Emily Blair

The universal redneck: Representations of rednecks and hillbillies in contemporary country music

Ever since local color writers at the turn of the 20th century crafted the falsehood of the Appalachian "Other" in America, Appalachians and Southerners alike have dealt with the largely negative stereotypes evoked by the words "hillbilly" and "redneck." This study focuses on the contemporary use of the terms "redneck" and "hillbilly" in popular country music in the past five years. Of the 181 songs that reached the #1 position on the Billboard charts in either "Hot Country Songs" or "Country Airplay," four included the aforementioned terms, just over two percent of the total. This study analyzes three of those songs: "Boys 'Round Here" and "Hillbilly Bone" by Blake Shelton, and "Country Must Be Country Wide" by Brantley Gilbert. By examining the contexts of the terms hillbilly and redneck within each song, as well as the images and actions associated with the terms in the music videos, the researcher found some similarities among the songs. First, each song attempts to universalize "rednecks" or "hillbillies" to include individuals outside of the geographic, racial, and class boundaries that have been traditionally associated with these terms. Secondly, the songs redefine these terms from a largely racist and exclusionary past to a more diverse, inclusive group of like-minded individuals. This study raises questions about the implications of these redefinitions and suggests directions for further research.

Mentor(s): Dr. Betty Fine

3. Naomi Butler-Abisrror

Influence of the elastic modulus of aligned electrospun fibers on mesenchymal stem cell behavior in collagen gels

Rupture of the anterior cruciate ligament (ACL) is one of the most common injuries of the knee, with over 200,000 patients diagnosed annually. Due to the limitations of current autograft and allograft treatments such as limited donor tissue availability, and poor integration and healing response, alternative treatments such as tissue engineering are being investigated. The objective of this study was to determine whether the orientation, proliferation, and adhesion of mesenchymal stem cells (MSC) to aligned fiber meshes is dependent on substrate mechanical characteristics. Aligned electrospun fibers composed of varying blends of poly(ε-caprolactone) and polyurethane were fabricated and characterized through scanning electron microscopy and monotonic mechanical testing. The fiber diameter, alignment, and elastic modulus of the various blends were compared to determine which materials have distinct properties. Rat MSCs were seeded within collagen gels onto mechanically different meshes and cultured for up to four days. At 6, 24, and 96 hours following seeding, samples were fixed in formaldehyde and stained with rhodamine-phalloidin to visualize the actin cytoskeleton and counter-stained with DAPI to visualize the nuclei. The shape and orientation of the cells were characterized to determine if cell adhesion and alignment to the underlying fiber mesh over time is influenced by its mechanical characteristics. These materials can be used to study how mechanical properties influence mesenchymal stem cell behavior without varying fiber diameter or alignment.

Mentor(s): Dr. Aaron Goldstein

4. Durga Dahal

Effective cellulose based oral drug delivery systems for the treatment of HIV

Human immunodeficiency virus (HIV) is a virus that damages the immune system and can lead to other life threatening diseases such as neurological problems or AIDS. Due to this prevalent infection of HIV, drug dispersion formulations have been conducted to prevent the inception and spread of the disease as multiple drug combinations, which can be more convenient for patients and more affordable for use in third- world countries. The oral route of drug delivery is a convenient method of administering drug, however most of the HIV drugs are poorly water soluble because of their high hydrophobicity and crystallinity. Thus, to overcome this obstacle, amorphous solid dispersion (ASD) formulation has been implemented to trap the poorly water-soluble drugs in their amorphous forms for the enhancement of dissolution rate and bioavailability. Herein, ASDs were prepared by co-precipitation method with various cellulose derivatives of different hydrophobicities; cellulose acetate suberate (CASub), cellulose acetate propionate adipate (CAAdP), 6-carboxy-cellulose acetate butyrate (CCAB) and carboxymethylcellulose acetate butyrate (CMCAB), in order to increase dissolution rate of ritonavir, etravirine and efavirenz. Amorphous solid-state property of precipitates was shown by X-ray diffraction and dissolution studies, which showed an increment of solubility of three drug combinations at small intestine pH (6.8).

Mentor(s): Dr. Kevin Edgar

5. Crystal Davis

Neural anatomy of human color preference

By using data from functional magnetic resonance imaging in conjunction with data from a behavioral study, the goal of this research is to understand the physiological basis of color perception in regards to preference. Participants of this study were shown 8 different circles of color, as well as circles of gray, as the control, while being scanned in fMRI. Colors chosen were equal in saturation and lightness, with hue being the only variable, and were equal distances apart on the CIE LUV color space. It is anticipated that neural activity when viewing preferred colors will be different from neural activity when viewing unpreferred colors. The behavioral portion of the study had participants view each possible color pair and rate which of the two they preferred, providing implicit color preference data. Participants were then asked to overtly state their preferred color. Analysis of behavioral data will focus on differences and similarities between the implicit and overt responses in order to further contemplate whether overt responses of color perception are dependable.

Mentor(s): Dr. Anthony Cate

6. Francis DeBenedictis

Perilipin 2's role in lipid storage mechanisms for skeletal muscle

The presence and advantage of body's need to tightly regulate energy expenditure and mediate the usage of energy within the cell to only the absolutely necessary level is evidenced by the presence of intracellular energy storage in the form of lipid droplets. This means creation, maintenance, and utilization of lipid droplets within skeletal muscle represents an important metabolic pathway, the dysfunction of which could be involved in the development of insulin resistance and disease such as type 2 diabetes. These intracellular lipid droplets are contained within a primary phospholipid monolayer with a host of associated proteins of which the perilipin family of proteins plays an integral role in lipogenesis and lipolysis. Perilipin 2 has an active role in lipid droplet storage, specifically protecting the droplet from being utilized improperly or prematurely during muscle exercise. This experiment is designed to determine the relationship between dietary fat intake and its effect on perilipin 2 levels within muscle tissue. If a direct relationship can be determined between perilipin 2, with its function in intercellular lipid storage, and fat intake than it could impact treatment options for insulin resistance and diabetes.

Mentor(s): Dr. Madlyn Frisard

7. Diego De La Torre Campos

Blast induced traumatic brain injury and the effects of DNA on methylation

Blast-induced traumatic brain injuries (bTBI) account for a significant amount of traumatic brain injury (TBI) cases found in soldiers, with additional injuries involving a combination of blast with vehicular accidents and/or falls, among others. Blast waves cause various internal responses within the body, but the exact mechanics of how the shock wave travels through the head and damages the brain are not fully understood. TBIs resulting from blast exposure are profound and widespread, including cellular dysfunction, atrophy and aberrant epigenetic gene expression. DNA methylation is an epigenetic tool used in regulating gene expression and has been shown to influence normal neuroplasticity, learning and memory. The hippocampus and prefrontal cortex contribute significantly to these functions. Therefore, the aim of this work is to elucidate changes in the methylation status of DNA and the enzymes controlling DNA methylation following bTBIs. To do so, global methylation levels were measured in the hippocampus and prefrontal cortex of rats subject to a blast injury. Various blast overpressures (10, 17, 23 psi) and various time points following injury (1 week, 2 weeks) were investigated. Using RTPCR, significant changes in levels of DNMT enzymes, DNMT1 and DNMT3b, were found in the hippocampus, while the prefrontal cortex exhibited no significant changes, which suggests that these enzymes may contribute to altered DNA methylation following injury. Global DNA methylation will be investigated using a commercial kit. It is hypothesized that changes in DNMT1 and DNMT3b expression will correlate with altered DNA methylation states, which may play a critical role in the response and recovery following bTBIs.

Mentor(s): Dr. Pam VandeVord

8. Kathryn Dunn

Small towns in transition: A green infrastructure approach

The original purpose of this research was to examine the concept of shrinking cities and vacancy through different scales from larger cities to small towns, and how interventions such as green infrastructure could help mitigate the amount of perceived vacancy. Case studies such as Cleveland, OH, New Orleans, LA, and Philadelphia, PA, were examined to show how these places have used green infrastructure approaches and how smaller towns, such as Christiansburg, VA, can put forth new strategies similar to those used in larger contexts. However, reviewing the literature related to shrinking cities, as well as analyzing Christiansburg's demographics and population trends, the current definitions for shrinking cities does not lend itself to smaller towns. Christiansburg, a small town located in the Blue Ridge Mountains of Virginia, is growing in population; yet, its downtown area along Main Street is currently suffering from a loss of businesses and increase in unoccupied building space. This current shift, in turn, has had a negative impact on the perception of downtown Christiansburg's spatial qualities, social interactions, and economic development. The question remains, is downtown Christiansburg truly vacant, according to traditional definitions of the term? How can interventions such as green infrastructure change the community's perception of vacancy from a negative view into a positive opportunity? By examining transportation and commercial development patterns, and analyzing historical maps of Christiansburg, one can speculate that this idea of vacancy is not permanent, but rather temporal. This is turn could change the way Christiansburg residents view vacancy, and could shift the way citizens think about where they live, and potentially develop a new theoretical framework that are in not necessarily focused on shrinking, but shifting.

Mentor(s): Brian Katen and CL Bohannon

9. Solmaz Eskandarinezhad

Study of Nitrogen Fixing Bacterial Communities in two ecotypes of Switchgrass, Alamo and Dacotah

Increasing global demand for fuel has catalyzed research to produce alternative renewable fuels. The growth of feedstock, such as Switchgrass, can help toward this goal because they produce high yields, are environmentally adaptable, and can potentially grow well on low fertility lands. In particular, nitrogen fixation associated with feedstock grasses such as Switchgrass could further help these biofuel grasses grow sustainably over many decades. The ability to utilize and improve upon the natural nitrogen fixing system in Switchgrass will serve to increase this source of biofuel and the world's energy needs. Two ecotypes of Switchgrass, Alamo and Dacotah, adapted to different environments and having different growth rates were chosen to test the hypothesis that the former has greater nitrogenase than the latter. These two cultivars were studied during early plant growth to assess bacterial nitrogenase activities in the. DNA based molecular gene assays (16S rRNA) showed a tendency for different cultivable bacterial communities in the rhizosphere, however, rates of nitrogenase at this early growth stage where low and not different between Switchgrass cultivars. The results suggest communities in the two ecotypes differentiate early following germination. It is speculated that plant N demand during this time is also low and thus explain the low rates. It is hypothesized that as the plants continue to grow and demand for nitrogen increases, that greater nitrogen-fixing activity will be measured in Alamo. The extents to which different bacterial communities contribute to this difference, if further confirmed, are expected.

Mentor(s): Dr. Mark Williams

10. Iriat Faisal

Irreversible Electroporation of Bacteria in Suspension

Irreversible Electroporation is a technique used towards cancer treatment in order to create pores in a cell membrane that do not close, eventually killing off the cell. An electrical pulse is generated in the cell membrane, leading to the pore formation due to an applied electric field that alters the transmembrane potential. The electric pulses are mimicked in a biomaterial to determine the best distance-to-voltage ratio that causes IRE. The biomaterial used, bacterial cellulose, is ideal due to its biocompatibility and mechanical integrity. The bacteria used in this experiment, Gluconacetobacter Xylnius, was used to create bacterial cellulose by placing it in water. The bacterium swims in the media and expels cellulose as the bacteria moves. After about a week, a pellicle formed and the pellicle is removed and the new media is split to make more bacterial cellulose. The cellulose creates a dense network of fibers when it is in static culture and is left undisturbed. These fibers mimic the bone, making it an ideal biomaterial for bone scaffolding. . If IRE is used to kill bacteria at specific time points and specific places, pores or holes in the fiber are created. To determine the threshold to cause IRE, the voltage-to-distance ratio is altered in order to predict pore sizes in the cellulose network. From this threshold, IRE is then used to create a bone scaffold.

Mentor(s): Dr. Rafael Davalos and Adwoa Baah-Dwomoh

11. Floricel Gonzalez

Identifying genes enabling bacteriophage 7-7-1 resistance in Agrobacterium sp. H13-3 via transposon mutagenesis

The host range of bacteriophage 7-7-1 is exclusive to Agrobacterium sp. H13-3. Bacteriophage 7-7-1 attaches to the rotating flagella of Agrobacterium sp. H13-3 and is believed to make its way down the flagella via a nut and bolt mechanism. Once at the flagella base, phage 7-7-1 is able to interact with cell surface receptors and inject its DNA into the bacterial cell. Lysis of the infected bacterial cell allows the phage to propagate and continue to infect other bacterial cells. However, past research has found that phage 7-7-1 cannot infect non-motile Agrobacterium sp. H13-3 due to the absence of flagellar rotation. The location of the mutations within the Agrobacterium sp. H13-3 genome that enable bacteriophage 7-7-1 resistance have not yet been identified. The purpose of this study is to locate non-motile and motile phage resistant Agrobacterium sp. H13-3 mutants. These mutants will be identified via a screening of 1000 colonies that have been selected for Transposon insertion. Additionally, "transposon-specific sequencing" will allow pinpointing of the genetic variations enabling phage 7-7-1 resistance within non-motile and motile mutants. A bioinformatics analysis of the transposon insertion sites within the non-motile and motile mutants will be provided.

Mentor(s): Dr. Birgit E. Scharf

12. Carolyn Greene

Flavor compound analysis of Horchata de Chufa

Horchata de chufa is a beverage made from a nutsedge (Cyperus esculentus L.), a grass plant that produces tubers, much like peanuts, which is popular in Spain. Horchata may look like soymilk, but horchata has a naturally occurring pleasant, nutty flavor. Studies show that Horchata de Chufa from different geographical locations have different flavor and chemical characteristics (fatty acid profiles), but very little information is available on the compounds present in horchata that contribute to its flavor. The purpose of this study is to identify the volatile flavor compounds that provide the distinct flavor of chufa. Flavor compounds will be isolated by using simultaneous distillation and extraction and solid phase micro extraction and will be identified by using gas chromatography mass spectrometry and gas chromatography olfactometry (using human nose as detector). Possible future implications of this study could include potential for enhancing the quality of Horchata de Chufas, producing horchata flavored confectionery items, and using flavor profiles as geographic markers. A better understanding of the chufa's flavor profile will also aid in marketing the exciting beverage as a product in the United States

Mentor(s): Dr. Sean O'Keefe

13. Brandon Gulledge

Nonlinear modeling of a bicycle tire in ABAQUS

According to the National Highway Traffic Safety Administration, an average of 699 pedalcyclist (one who operates solely pedal-powered vehicles) fatalities have been reported each year from 2003 to 2012, with the Centers for Disease Control and Prevention estimating 515,000 serious bicycle-related injuries in 2010. Following this fact, it is the engineer's responsibility to be able to appropriately analyze design features of bicycles in order to improve safety and minimize the cost of components. Bicycle tires in particular, are one of the most complex mechanical systems to analyze due to their constitutive behavior resulting from interactions between several material compositions. As such, it is of interest to be able to more effectively model bicycle tires for the purpose of improving cyclist safety and manufacturing efficiency. The models used for tire analysis are typically in the form of computer simulations using the Finite Element Method (FEM) to describe the mechanical behavior seen from tires. This research seeks to use the FE program, ABAQUS, to effectively model a bicycle tire subjected to various loading conditions and use physical testing to determine the constitutive mechanical properties therein. As such, this research stands to improve the safety of cyclists by providing knowledge to the field of bicycle tire design.

Mentor(s): Dr. Rakesh Kapania and Arafat Khan

14. Abbey Hammell

A multimethod examination of attention in middle childhood: Frontal EEG and maternal report

Attention acts as a catalyst for our goals by selecting and prioritizing information necessary for everyday life. Posner and colleagues developed a theory of three attention networks: alerting, orienting, and executive attention. These three networks involve different brain systems, but also work together and are functionally mature by middle childhood. Parent rating scales are traditionally used to assess children's attentional behaviors. However, little neuropsychology research has been done to examine the neural and behavioral validity of these questionnaires. Seventy local community children (ages 9-11) from an ongoing longitudinal study participated. During the lab visit, children wore an EEG cap while performing the Attention Network Test (ANT). Mothers also completed behavioral-rating scales: the Child Behavior Checklist (CBCL) and the Early Adolescent Temperament Questionnaire (EATQ). We examined the attention-problems scale of the CBCL and the attention scale of the EATQ. Regression analyses demonstrated that task-related changes in frontal EEG and maternal ratings on the EATQ uniquely predicted alerting, but not orienting or executive attention. The CBCL, a measure of attention problems, did not predict ANT scores or EEG activity. This study demonstrates the value of a multi-method approach to studying attention. Furthermore, it suggests that future investigations need to focus on the predictive power of the CBCL in a community sample.

Mentor(s): Dr. Martha Ann Bell

15. Chelsea Horton

Investigation of canine fecal lactoferrin as a biomarker for intestinal inflammation in dogs

Inflammatory Bowel Disease is a common disease affecting dogs. In human studies, a glycoprotein called lactoferrin is directly correlated with the severity of inflammation in the intestines. The Purpose of this study was to determine if canine fecal lactoferrin concentration varied between Giardia infected and uninfected dogs as determined by Meridian Merifluor and Zinc Sulfate results. Stool samples were collected from 100 (58 infected, 42 uninfected) dogs. Samples were randomized and lactorferrin was measured using a customized quantitative enzyme linked immunosorbant assay (ELISA). Median canine fecal lactorferrin concentration was significantly higher (P-value < 0.0001, Mann Whitney) in Giardia infected dogs (8.79 µg/ml) than in uninfected dogs (0 µg/ml). Canine fecal lactoferrin did not correlate with the number of Giardia cysts but median concentrations were significantly different when comparing fecal consistency scores (Kruskal-Wallis, P < 0.0198). Increased fecal lactoferrin appears to be associated with Giardia infections in dogs. These findings suggest canine fecal lactoferrin may serve as a biomarker for intestinal inflammation. In future studies this analyte may prove useful in distinguishing between inflammatory and neoplastic intestinal disorders in dogs.

Mentor(s): Dr. Tanya LeRoith

16. Gisella Kakoti

Algorithmic Parameterization of a Budding Yeast Cell Model
Gisella Kakoti

The Quasi-Newton Algorithm for Stochastic Optimization (QNSTOP) is a computer algorithm developed for stochastic and deterministic optimization of objective functions that involve uncertainty and random noise. QNSTOP is particularly useful for functions with high dimensionality and numerous local minima. The algorithm has a broad range of applications, such as biomechanics, acoustics, traffic networking, medicine, and aerospace engineering. My research focused on utilizing QNSTOP to predict changes in budding yeast cell cycles. More specifically, I analyzed experimental data on G1 phase duration and the masses of mother and daughter yeast cells before and after cell division. The budding yeast cell model has 143 rate constant parameters, most of which are problematic to calculate directly from experimental results. Usually modelers deduce these parameters through a process called "parameter twiddling," in which they make a series of educated guesses and compare simulation results with experimental data. QNSTOP automates this process and provides better estimates by comparing probability distributions of the simulations to the experimental data. This algorithm can be utilized in future research as a faster and more accurate method of parameterization.

Mentor(s): Dr. Layne Watson

17. Josef Mang

The effect of PDL-1 upregulation on the swine immune system in PCV2

Porcine circovirus-associated disease (PCVAD) is a globally-encompassing disease that has been found to infect the majority of the world's pigs. PCVAD is the blanket term given to a collection of syndromes resulting from infection of porcine circovirus type 2 (PCV2), which is one of leading causes of mortality and loss of value of swine livestock in swine-related industry. One of the characteristics of PCVAD is the depletion of the host's lymphocyte count, which contributes to the downward spiral that is an immune system that cannot recover. One particular gene, PDL-1, is a key member of a signaling pathway that induces cellular death on lymphocytes and is thought to be upregulated during PCVAD. Results have shown that inflammatory response to PCV2 infection is thrown out of balance as intrinsic genomic sequences of PCV2 suppress select cytokine secretions. This imbalance of antiviral response could possibly upregulate PDL-1 expression, effectively depleting lymphocytes. Interleukin-6 (IL-6) is one such cytokine that has been shown to be vital to the upregulation of PDL-1, and during PCV2 infection, IL-6 is one of the few cytokines that is still expressed. In conclusion, this review points to the possibility that PCV2 infection, culminating in PCVAD, may stimulate the formation of lymphocyte depleted lesions as a result of upregulating PDL-1.

Mentor(s): Tanya LeRoith

18. Tiara McDonald

Polyether ether ketone (PEEK) matrix reinforced composites

The purpose of this study was to generate polymer matrix reinforced composites consisting of nano carbon particles and the polymer Polyether Ether Ketone (PEEK) with the mixing technique of mechanical alloying. The polymer PEEK was mixed with 35 hour SPEX milled graphite that was divided into five different weight percent categories; 1%, 5%, 10%, 20%, and 30% with a 1.5 charge ratio. The two metal balls used for mechanical alloying of the two powders, combined weighed 16.42 grams while the total mass for the powders inside of the vials was 10.94 grams. Two samples for each weight percent was mixed so each sample could be milled for five hours and then another sample for ten hours. The weights for the graphite for 1%, 5%, 10%, 20%, and 30% were 0.109 grams, 0.547grams, 1.094 grams, 2.188 grams, and 3.282 grams respectively. The atomic and molecular arrangements of the milled PEEK samples were observed by X-ray diffraction that displayed a large number of scattered waves. The change of the samples' heat capacity by temperature was then recorded by Differential Scanning Calorimetry (DSC) analysis. For the DSC analysis of PEEK, the 2D linear graphs indicated two dips, the first one indicating the glass temperature and the larger dip indicating the melting point of PEEK. The specimen with the most PEEK composition and longer milling time, 1wt% at ten hours, had the largest dips displayed on the graph because of the physical properties of PEEK when compared to the other specimens.

Mentor(s): Dr. Alex Aning

19. Alex Newman

Ultra high Molecular weight polyethylene (polymer matrix)

Ultra-high-molecular-weight polyethylene (UHMWPE) is a type of thermoplastic polyethylene. Composite materials are made up of two or more materials on a macroscopic scale. A Polymer matrix is comprised of plastics within which contain structured fibers known as the reinforcement. Various tests were used in order to determine the strongest version of the material. First, in order to reduce the particle size as and make a more homogenous mixture, the polymer was mixed with Graphite that was milled for 35 hours through the process of mechanical alloying. Multiple samples were mixed in weight percentages that include 1%, 5%, 10%, 20%, and 30%. The milling was achieved by weighing out a calculated amount of each sample and placed in a metal jar along with two metal balls. The samples were then placed in a machine at intervals of 5 and 10 hours at a time. The UHMPWE mixture was then casted into sheets by collecting approximately 8 grams of the material and molded using the Dake Heat Press machine. In order to get a satisfactory sheet, a heating time of 40 minutes at 3psi was necessary in addition to letting the sheet cool. X-ray diffraction techniques were then used in order to examine the atomic as well as molecular arrangement of the samples. In addition, Differential Scanning Calormetry (DSC) was then used to test how the material's heat capacity (Cp) is changed in relation to temperature. The data, shown through a graph, includes two dipping points that indicates glass temperature and melting points respectively. Finally, cutting the sheets by means of a Tensile test was need to measure the strength of the material. It was predicted that increasing the weight percentage in concert with the higher heating time (10 hours) would result in the strongest and sturdiest version of the polymer matrix.

Mentor(s): Dr. Alex Aning

20. Christopher Owusu-Sampah

Olivine chemical analysis and Raman spectroscopy

The analysis and utilization of olivine is advantageous to the geosciences, as it provides valuable information of the source and evolution of magmas. Olivine (Fe, Mg)2SiO4 serves a multitude of purposes, from taking a chemical "snap-shot" of a magma chamber, called a melt inclusion, to measuring how hot the magma was at particular stages, known as a geothermometer. Due to its importance, it is of prime concern to develop quick, accurate, and non-destructive methods of analysis. The standard method uses an Electron Microprobe (EMP) to determine olivine's major elements (Si, Fe, Mg). The information obtained from the microprobe is used to calculate the modal Mg-number (Mg#=MgO/(MgO+FeO)), a value that determines the state of evolution of the magma that crystalized the olivine. However, a potential alternative to Electron Microprobe analyses for the determination of Mg# is Laser Raman Spectroscopy. Instead of bombarding electrons at the sample and looking at the respective x-rays, the Raman spectrometer uses the Raman scattering effect to observe the vibrational modes of the molecules comprising the olivine. After fitting a Lorentzian curve to each resulting wavelength peak, recorded on a Raman shift vs. intensity graph, the peak intensity varies linearly with Mg#. Because a laser is used, however, factors such as light polarization, intensity, and rotation must be accounted for in Raman analysis. Our goal is to calibrate the Raman technique to produce the same level of accuracy as with the EMP but with a higher efficiency.

Mentor(s): Dr. Esteban Gazel

21. Bishal Paudel

Selected gene expression in response to iron deficiency in potatoes

Potato (Solanum tuberosum) is an important food crop not only because it is a good source of carbohydrates, proteins, and vitamin C, but also due to the fact that it is an intriguing source of micronutrients such as iron and zinc. The purpose of this study was to improve the micronutrient component of potato tubers by understanding how genes respond to iron deficiency in the nutrient media. We used a tissue culture system to grow homozygous potatoes in order to observe possible differences in gene expression for genes that are responsible for iron acquisition from the media. A number of candidate genes were found to be up-regulated in the potato cultivars grown in the iron deficient media compared to the potato cultivars grown in normal iron supplemented media. We expect that the difference in gene expression among cultivars is associated with differences in the nucleotide code of the single alleles per gene within each cultivar. Potato plants with superior alleles at these loci may be expected to have an advantage in acquiring micronutrients from deficient soils. The results from this study will help in the biofortification of potatoes via gene editing, which will eventually benefit the human population, especially in regions where populations subsist on potato varieties that are currently deficient in micronutrients.

Mentor(s): Dr. Richard Vellieux

22. Diana Pham

Studies on matrix stiffness and cell malignant morphology with constructed three-dimensional mammary tissues

The increased stiffness of the extracellular matrix (ECM) promotes malignant behavior of cells by clustering integrins. This clustering causes an increase in Rho activity that disrupts the normal homeostasis of a cell. Previously used two-dimensional cultures were shown to intensify this issue with their rigid substrata so more cultures with compliant three-dimensional ECM are used. The aim of this study is to extend these three-dimensional cultures to include a vascular system to test the effects of ECM stiffness on the phenotype of mammary epithelial cells. The effect of matrix stiffness on cell morphology is therefore examined in a more realistic representation of the in vivo environment for cells. The procedure for creating the 3D ECM is still in progress. It essentially involves printing a 3D carbohydrate structure that is used as a temporary structure. The carbohydrate structure is coated in polymer poly(d-lactide-co-glycolide) (PDLGA). When this structure is put into a mixture of collagen and cell media, the carbohydrate lattice in the structure dissolves, leaving the PDLGA as channels for flow of nutrients and other necessary substances while encasing it in a collagen ECM. The concentration of collagen can then be varied within the ECM to resemble different ECM stiffness. This study provides a way to examine how the ECM stiffness affects the morphology and malignancy of cells with a vascular system to further understand how mammary cells can undergo tumor formation and metastasis.

Mentor(s): Dr. Carla Finkielstein

23. Juliana Pham

Studies on the regulation of Endosome-Associated FYVE-domain binding to phosphatidylinositol 3-phosphate

Endosome-Associated FYVE-domain protein (Endofin) is an adaptor protein that plays a role in membrane trafficking, in which cargo is transported to its designated location. Its FYVE (Fab1p, YOTB, Vac1p, EEA1) domain binds specifically to phosphatidylinositol 3-phosphate (PtdIns(3)P), and this association allows the protein to localize to early endosomes. To better understand how Endofin is regulated, the lipid binding will be tested in the presence of TOM1 to determine if TOM1 modulates the binding. Since TOM1 modulates Tollip activity, it is a good candidate for the regulation of Endofin binding to PtdIns(3)P. SDS-PAGE analysis demonstrated that the GST-fusion Endofin FYVE domain has been purified to homogeneity. Lipid-protein Overlay Assay established binding between GST-fusion endofin FYVE and PtdIns(3)P, phosphatidylethanolamine (PE), and phosphatidic acid (PA). The purification of full-length Endofin and the effect of TOM1 in Endofin's lipid binding are currently in progress. We seek to establish whether TOM1 modulates lipid binding to predict TOM1-mediated common modulation principles.

Mentor(s): Dr. Daniel Capelluto

24. Chris Reina

Design and testing GNSS TEC Measurement Software infrastructure"
Authors: Chris Reina, Ahmed Eltrass and Wayne Scales

A constant problem engineers face is accurately quantifying the Total Electron Content (TEC) in the ionosphere to eliminate the error and deliver more precise positioning results. The ionosphere is part of the upper layer of the atmosphere that constantly produces errors in GPS. The ionosphere is a layer with an abundance of electrons, which slows down the signal transmitted from the satellite to the receiver. The purpose of this study is to examine the TEC data and ionospheric delays for the Blacksburg area. In this project, time delay and TEC data are plotted through MatLAB using both the L1 and L2 signals from a dual frequency receiver. Dual frequency receivers offer very accurate results because a delay can be measured from the change in time between the L1 and L2 signals reaching the receiver. Furthermore, when the delay is multiplied by a constant factor TEC data can be produced. These results are compared to the Klobuchar model, which measures ionospheric delay using only L1 signals and accounts for 50 percent error. Based on current data, it is expected that the dual frequency receiver and Klobuchar model will not have exactly the same shape; however, the peak in delays should be relatively close to each other. Through this study, an entirely new method for obtaining ionospheric delay and TEC measurements has been found from the plotting on MatLab of navigation and observation files obtained from a NASA website and the receiver, which then can be applied later on by engineers to fix any error provided by the ionosphere

Mentor(s): Dr. Wayne Scales

25. Cedric Revell

Inhibition of the microtubule depolymerase Kif2a in PtK1 cells increases the stability of kinetochore-bound microtubules

Cell division or mitosis is the process by which each cell generates two genetically identical daughter cells. Errors in the transmission of DNA are at the base of cancer development and progression. Accurate chromosome segregation is ensured by proper interaction between the microtubules (MTs) of the mitotic spindle and the kinetochores, specialized protein structures that assemble on each chromosome at the level of the centromere. During metaphase, each chromosome aligns at the cell equator and maintains dynamic attachments to spindle MTs. Net addition of tubulin subunits at the microtubule plus-ends, which are attached to kinetochores, is balanced by persistent microtubule minus- end depolymerization at the spindle pole. MT dynamics and the activity of motor and non-motor proteins cooperate to modulate chromosome movements during metaphase and to ensure maintenance of proper KT-MT attachments. Kif2a is the major depolymerase responsible for depolymerization of tubulin at MT minus ends at the spindle poles. We asked whether inhibition of Kif2a, and hence suppression of MT minus end depolymerization, would affect the stability of MT plus ends, thus increasing the number of KT-bound MTs. We inhibited Kif2a by injecting an anti-Kif2a function-blocking antibody in live mitotic PtK1 cells, we then fixed and immunostained such cells, and finally measured the fluorescence intensity of KT-bound MT bundles. Our results indicate that Kif2a inhibition increases the number of MTs attached to KTs, possibly reflecting an increased stabilization of KT-MT attachments.

Mentor(s): Dr. Daniela Cimini

26. Alexandria Robinson

The effects of shock-wave blasts on the endocrine system

In recent years blast specific traumatic brain injury (bTBI) has become a more prevalent injury within our military personnel. With the increased use of explosive devices along with improvements in body armor, soldiers are surviving blasts that in the past would kill them. However, there are many other side-effects, including bTBI. Research has not yet uncovered the mechanism of injury from bTBI, but results have shown that damage can be drastic. This study focuses on how the blast wave effects the endocrine system specifically the hypothalamic pituitary adrenal (HPA) axis. The HPA axis is the main regulator of hormone production in the body, which when affected by bTBI and has been observed to cause hormone dysfunction. Enzyme-Linked Immunosorbent Assay (ELISA) and Polymerase Chain Reaction (PCR) were used to test the level and expression of Glial-Fibrillary Acidic Protein (GFAP), Leptin, and Adiponectin. The ELISAs were run using serum collected from laboratory rats two weeks after a blast event at 10, 17, and 23 PSI and un-blasted sham samples. The PCRs were run using cDNA extracted from adipose tissue collected from the same animals as the serum collection. The levels of these pituitary linked hormone/proteins will indicate how the pituitary is functioning after damage. The results have shown a defined increase from sham in all of the hormone/proteins tested, with elevations varying with blast pressure exposure. This suggests an over-active pituitary gland, most prevalent at the 10 PSI range.

Mentor(s): Dr. Pam VandeVord

27. Alexander Shimozono

Kinetics of inhibition of anopheles gambiae and human acetylcholinesterase by primary carbamates

Malaria is a mosquito-borne disease that kills over half a million people per year. Currently, there are over 1 billion people at high-risk of malaria infection. In many of these high-risk areas, insecticide-treated nets serve as the primary method of malaria control by killing the vector mosquito. Growing resistance to pyrethroid insecticides used to treat these nets has created interest in the development of new insecticides that possess a different mechanism of action but are sufficiently non-toxic to humans to allow application to nets. Specifically, insecticides that target acetylcholinesterase (AChE) have been proven to be effective methods of control against the African malaria mosquito (Anopheles gambiae) when applied to the upper reaches of interior walls (indoor residual spraying). Two issues that discourage use of these compounds on nets include a low selectivity against human AChE and the rise of an insecticide-resistant An. gambiae strain (G119S). We previously developed a series of aryl carbamates that have shown up to 500-fold selectivity for wild type (WT) An. gambiae AChE over human AChE. These compounds were toxic to susceptible strain An. gambiae, but unfortunately, none were appreciably toxic towards G119S resistant strains of An. gambiae. Recently, the Carlier group has discovered a class of carbamate that is highly toxic to both strains of An. gambiae, even though the molecules do not potently inhibit the resistant enzyme. To investigate the possibility that oxidative metabolism activated these compounds to create effective inhibitors of G119S An. gambiae AChE, we evaluated inhibition of AChE by primary carbamates.

Mentor(s): Dr. Paul Carlier

28. Michael Sibilo

Analysis of fungal bacterial abundance along chronosequence soil

Microbial communities and plants are major drivers of soil and ecosystem development, however, little research has been conducted to assess how they change and possibly feedback as part of the ecosystem-building process. Linkages between plant diversity and microbial communities may ultimately determine ecosystem functioning, for example. Samples were collected from a soil chronosequence in Wilderness Park, Michigan, from soils between 105 and ~4000 y since deposition and the start of soil pedogenesis. The purpose of this experiment was to characterize bacterial and fungal abundance changes resulting from changes in season and soil-ecosystem development. Changes in fungi and bacterial communities are a key part of a changing ecosystem and can provide clues to the dynamic process of soil development and soil function. Microbial abundance was measured using quantitative PCR (qPCR) of bacterial and fungal rRNA genes. qPCR was successfully used to determine the abundance of bacterial gene numbers, however, no differences were detected as a result of soil development. Fungal gene abundances are currently being collected. It is hypothesized that fungal to bacterial ratios will increase during soil and ecosystem development. The implications of this research are the ability to determine how ecosystems naturally develop and change and ways that plant, soils, and microbes co-develop to create ecosystems. If confirmed, the community change will be further investigated to understand its effects on ecosystem function and development.

Mentor(s): Dr. Mark Williams

29. Crystal Smitherman

Antibiotic resistant genes in dairy cow soil samples

Antibiotic usage by the dairy industry is known to result in high levels of antibiotic resistance in the animal. However, little is known about how this resistance is transferred to agricultural soils via manure inputs or how the function of soil microbial communities might be affected. Exposure of soil microorganisms to these antibiotics or antibiotic resistance genes (ARGs) can decrease microbial growth and increase demands for maintenance, possibly leading to changes in the soil microbial community and how these communities regulate carbon, nitrogen, and phosphorous cycling. The goal of this research was to determine if increased exposure to dairy manure inputs results in increased prevalence of ARGs in soil microbial communities. Paired soil samples from eleven different dairy research farms that compared high and low dairy manure inputs were analyzed for concentrations of ARGs. Specifically, quantitative PCR was used to quantify copies of ARGs for resistance to tetracycline (tetO and tetW), erythromycin (ermB), and cephalosporin (ampC), as well as total numbers of bacteria and fungi. Little change is expected in tetO, tetW, or ermB because tetracycline resistance is naturally abundant, while erythromycin is not naturally abundant, nor is it used regularly in the dairy industry. In contrast, cephalosporin is not naturally abundant but is commonly used therapeutically in the dairy industry, so the greatest difference in ARG concentrations is expected for ampC.

Mentor(s): Dr. Brian Badgley

30. Caleb A Wood

Impact of Cholinergic Activity on the Neuromuscular Junction

Lifestyle factors, such as exercise and diet, have been shown to attenuate structural degradation in aging neuromuscular junctions (NMJ), the synapse formed by motor neurons and skeletal muscle fibers. Because of the wide-ranging effects that these lifestyle factors have on the organism, it is unclear whether they directly affect NMJs. In this study, I used transgenic animals for the vesicular acetylcholine transporter (VAChT). In these animals, the level of acetylcholine released is increased (VAChT-Hyper) or decreased (VAChT-KD), resulting in higher and reduced muscle contractions, respectively. First, I determined the impact of directly modulating cholinergic activity on the motor system using two performance tests, the Rota-Rod and hanging tests. My preliminary results indicate that VAChT-Hyper mice are able to stay on the Rota-Rod and hanging for longer than control animals. I then examined the structural integrity of neuromuscular junctions in VAChT-Hyper and VAChT-KD mice. In VAChT-Hyper mice, there is an acceleration of age-associated changes at NMJs, characterized by fragmentation, denervation of muscles and degeneration of motor axons. These results indicate that motor axons and skeletal muscles are highly sensitive to changes in acetylcholine levels, suggesting that anti-aging interventions could target the mechanism that maintains normal levels of this neurotransmitter.

Mentor(s): Dr. Gregorio Valdez

31. Steve Smith

Cellulose nanocrystal gels: Novel high-perfomance gels for the food, pharmaceutical and cosmetic industries

Cellulose nanocrystals (CNCs) are produced from renewable resources (plants), are relatively low cost, non-toxic, and naturally biodegradable. The ability of CNCs to retain water and form gels makes them an attractive choice for incorporation into consumer products. Commercial gels can be found in the food industry, cosmetics, adhesives, pharmaceuticals, and others. This project aims to produce CNC gels and use atomic force microscopy and conductometric titration to characterize the nanocrystals. In addition, gels made from commercially available materials will also be prepared, and the gel strength and rheological properties of these gels will be compared to those made with cellulose nanocrystals.

Mentor(s): Dr. Maren Roman

31. Elliot C Shiben

Solar Flare Signatures in Nitric Oxide Emissions using SABER Data

The purpose of this study is to observe SABER data readings. SABER data is necessary to recognize solar flares and their impact on nitric oxide levels, as well as carbon dioxide levels, in the atmosphere. Nitric oxide levels increase as a result of solar flares due to the increase of energy in the upper atmosphere. In order to recognize and observe solar flares SABER data becomes necessary to understand their significance to our atmosphere . I am observing multiple readings from SABER and looking specifically for spikes in NO data which correlates to solar flares. As nitric oxide levels increase in the upper atmosphere (above 100 kilometers) there should be a direct relationship with solar activity. Eventually I plan to recognize whether or not SABER can observe these spikes in the nitric oxide levels or not as well as the severity of the impact of the solar winds on nitric oxide levels. Preliminary readings of SABER's data point towards an agreement of my predictions and a spike in nitric oxide levels during solar storms. This data will become more relevant when SABER's observations become closer to the equatorial region and and solar maximum hours are occurring.

Mentor(s): Dr. Scott Bailey

32. Heather G Wise

Determination of Biogenic Formaldehyde in Juvenile and Mature Wood

Determination of Biogenic Formaldehyde in Virginia Pine The government has recently lowered the amount of formaldehyde allowed in the atmosphere, raising concerns for wood composites manufacturers and their products. Although useful, lignin is responsible for a majority of biogenic formaldehyde production and observed to be higher in juvenile wood as compared to mature wood. This difference in lignin should produce a discernable difference in the amount of formaldehyde production, allowing manufacturers to minimize biogenic formaldehyde production through use of wood producing minimal formaldehyde. We took increment bores from Virginia Pine (Pinus virginiana), documented, and separated them into juvenile and mature wood. Using the serum bottle technique we extracted formaldehyde into water from both the juvenile and mature wood. Analyzing the water using a fluorimeter to determine the micrograms of formaldehyde per gram of wood we determined that there is no statistically significant difference between the formaldehyde content of juvenile and mature wood in Virginia Pine. This data will serve to allow wood composites manufacturers the use of juvenile and mature wood for the production of wood based composites without fear of increased biogenic formaldehyde production.

Mentor(s): Dr. Chip Frazier

33. Angela Burnop

Mechanical testing of aligned bacterial cellulose scaffolds for tissue engineering

In the United States 500,000 bone grafts are performed every year[1]. In treating bone defects, medical personnel face challenges when presented with osseous reconstruction. Patients must often undergo autogenous grafting requiring multiple surgeries increasing the risk of pain, infection, and loss of function. Bacterial cellulose (BC), synthesized by Gluconacetobacter xylinus is moving to the forefront of tissue engineering as a viable biomaterial for a diversity of tissue types including: small diameter blood vessels, cartilage, and bone [2]. The nanofibrils secreted by the bacteria create a scaffold that imitates the extracellular matrix using a dense, random network of nanofibers, exhibiting greater mechanical strength than plant cellulose [3]. Despite advances made in tissue engineering, obstacles remain in controlling tissue permeability for gas exchange and the movement of molecules across the engineered tissue. Electromagnetic fields will be used to direct the morphology of cellulose exuded by G. xylinus, aligning the nanofibers in a specific and controlled orientation. Cellulose production will then be blocked to create pores in the scaffold simulating microvasculature, allowing cell communication and molecular exchange between cells and the extracellular matrix. Alterations in the scaffold will likely change the mechanical properties of the bioengineered tissue. The strength of the porous scaffolding will be tested using tensile and biaxial testing.

Mentor(s): Dr. Rafael Davalos

34. Veronica M Kimmerly, Claire Ewing-Nelson

"Die Grippe has come." The Influence of "Expert" Information in Public Perception of the Russian Flu of 1889-1890

The Russian Flu of 1889/90 was transformative in that the telegraph allowed information about disease to travel faster than the disease itself for the first time in history. This allowed local public perception of the disease to be shaped by reporting prior to disease presence and these perceptions to be challenged as the disease reached the locality. Newspapers often reported statements given by "experts" such as medical doctors and bacteriologists. This "expert" information was often distorted as it was repeated across newspapers and across various languages. Our study seeks to understand how this "expert" information was distributed and how it helped shaped public opinion of the disease, including public response to this information. Medical texts and newspapers from France, Germany, the USA, and other countries will be compared to identify distortions in reported material, the newspapers will provide public response to the "expert" information, and medical texts after the epidemic will show how "expert" information changed as public opinion shifted. Expected outcomes of this project, are a better understanding of how "expert" information influences public understanding of disease, including how the newspapers translate "technical" language to a simpler language, and how public response affects changes in the "expert" information.

Mentor(s): Dr. Tom Ewing

35. Devon V Johnson

LISTENING TO THE LANDSCAPE OF CREATION: Benefiting quilt knowledge in Virginia's New River Valley through research and rhetoric

This project aims to compile existing research on quilting traditions in Virginia's New River Valley into a format accessible to both researchers and interested community members. This project takes a unique approach to the idea of "audience" by addressing the needs and interests of both craft researchers and the crafters themselves. The project will analyze and implement ideal modes of disseminating information among these audiences and will explore how research and rhetoric can be made to benefit both researchers and craftspeople--an important goal of folklore research. The ultimate goal is the creation of a database, or other appropriate professional-writing document, that represents the current body of quilt knowledge in the New River Valley, specialized for the audiences discussed above. Materials for inclusion in the database include summaries of 42 oral histories collected in the 1970s, quilt documentation forms collected in the 2000s, and information on various quilting techniques and traditions identified by quilters. This project also provides food for my honors senior thesis.

Mentor(s): Dr. Carlos Evia

36. Brent Holt

DYNAMICS OF WATER DROPLET AFTER IMPACT ON A HYROPHOBIC SURFACE

Recent research has focused on the static structures and properties of water-repellent leaves from plants such as Nelumbo nucifela. However, there is limited knowledge regarding the dynamics of rebounding rain droplets as they impact hydrophobic leaves. In this study, the dynamics of a water droplet impacting a thin substrate was investigated as a function of drop impact speed and substrate's elasticity. Water droplets with a diameter of approximately 3.4 mm were released from heights varying from 20 mm to 150 mm which impacted a hydrophobic, polycarbonate cantilevered beam with varied lengths from 20 mm to 150 mm. High-speed video photography techniques were used to capture the rebound characteristics of the droplets as well as the response of elastic cantilevered beams. Images were analyzed using MATLAB to measure initial impact speed, rebound heights and velocities, and cantilevered beam deflection.

Mentor(s): Dr. Sunny Jung

37. Stephen T Kamanda

Puncture, Pump, and Suck: How does the Brown Marmorated Stink Bug Actually Feed?

Puncture, Pump, and Suck: How does the Brown Marmorated Stink Bug Actually Feed? Stephen Kamanda, Melissa Kenny, and Jake Socha In 1998, the Brown Marmorated Stink Bug (BMSB), Halyamorpha halys, was accidentally introduced into the United States after hitching a ride on a boat from Asia. In only 16 years since, they have spread across most of the continental US, becoming a nuisance to households and a pest with real economic consequences for businesses and agriculture. These invasive bugs have the ability to feed on a wide range of tree fruits, seedpods, vegetables, and even the bark of certain trees with only a flexible feeding tube. This impressive feat may help to explain its robustness and ability to thrive in many different environments. Our study examines how the BMSB consumes such a variety of sources by studying the appendages at the tip of the BMSBs' proboscis. We examine how the proboscis functions during feeding, including how the bug takes its food through the narrow channel to its gut. Scanning Electron Microscopy (SEM) images of the appendages will help us to understand the structure and mechanics of food piercing. This is then related to its function by synchrotron X-ray images taken at the Advanced Photon Source of Argonne National Laboratory in Illinois. These techniques will reveal the methods of puncture and sucking during feeding. It is our hope that this study into how the BMSB feeds will lead to bio-inspired devices and/or microfluidic devices.

Mentor(s): Dr. Jake Socha

38. Nicole N Capriola

Children's socioemotional adjustment and bullying experiences: The moderating role of gender

Peer relationships are integral to children's emotional adjustment, particularly during the transition to adolescence when children increasingly rely on peers for emotional support. Previous studies have linked poor peer relationships and decreased sense of belonging to poor psychological adjustment, such as increased stress, anxiety, and behavior problems (Klimes-Dougan et al 2013). The present study examines 8th grade children's experiences with bullying in relation to their emotion regulation abilities and behavior problems. Parents and children completed questionnaires by mail, such as the Strengths and Difficulties Questionnaire (SDQ) and Illinois Bullying Scale (IBS). The present research focuses on the relationship between bullying, as measured by the IBS, and children's emotional and behavior problems, as measured by the SDQ. We expect that poor emotion regulation and behavioral problems will positively correlate with victimization. We also expect a moderating effect of gender, where boys who are reported having poor emotion regulation skills will experience greater physical victimization as well as engaging in more physical aggression. In contrast, we expect that girls who are reported having poor emotion regulation will report higher levels of relational victimization as well as engaging in more relational aggression.

Mentor(s): Dr. Julie Dunsmore

39. Samantha Phanthanousy

The Influence of Pallet Stiffness, Box Stiffness, and Box Geometry on Load Bridging

Pallets are flat and essential components used to efficiently transport and store goods. They are used in a wide variety of industries from retail warehouses to grocery stores. Pallets are typically designed with the assumption that the weight of unit loads will be uniformly distributed on the pallet surface. However, in reality, packages vary and tend to bridge between each other. Though there has been acknowledgement of load bridging, the research is minimal on the interaction between the physical characteristics of unit load components and load bridging. This load bridging phenomena can affect the deflection of the pallet that could potentially influence its load carrying capacity. The purpose of this study was to observe the influence of packaging stiffness, packaging geometry and the number of layers on the amount of deflection during a warehouse racking condition. A bending test and pressure pad system were used simultaneously to measure the deflection and stress distribution of the testing samples using three different pallet stiffnesses to gain information on the amount of load bridging. The experiment results led to the conclusion that packaging geometry, packaging stiffness and the number of layers have a significant effect on the deflection of the pallet.

Mentor(s): Dr. Laszlo Horvath, Jonghun Park

40. Tiffany S Hunter

Constructing 3D Microfluidic Collagen Hydrogels to Quantify Nanoparticle Transport

Fluid transport and flow velocity in blood vessels within the tumor microenvironment may affect tumor angiogenesis and decrease the effectiveness of therapeutic drugs. It can also significantly affect the efficacy of nanoparticle-based treatments, including photothermal-enhanced chemotherapy. Therefore, it is important to model and analyze the differences between nano particle transport, within the tumor microenvironment, under varying conditions (with endothelial and human breast carcinoma cells-MDA-MB-231 and without endothelial cells and MDA-MB-231 cells) in order to determine the roles of cell-nanoparticle interactions. These interactions include aggregation and uptake of transport across a blood vessel and transport within the tumor microenvironment. The objective of this study is to construct 3D collagen hydrogels, from rat tendons, and quantify the shear stress under varying conditions (flow rate, nanoparticle sizes, and collagen matrices properties). The quantifying agents are as follows: MTB 2004 Test used for imaging under physiological conditions, Camera Control Pro 2 and Micro-Manager 1.4 which analyze fluorescent intensity throughout the hydrogels, representing nanoparticle transport. The results of the flow velocity under non-cell conditions will be compared to hydrogels with endothelial and breast carcinoma cells embedded in the walls of the hydrogel.

Mentor(s): Dr. Matthew DeWitt

41. Tyler M Miklovic

Prediction of IRE and H-FIRE Lesions using In Vivo Experiments and Computational Modeling

Several focal ablation techniques are being researched in order to more effectively treat tumors. However, many rely on thermal damage mechanisms which can put critical structures at risk. Irreversible Electroporation (IRE) is a non-thermal, minimally invasive technique to ablate tumors and other undesirable tissue located near major vasculature [1]. Our group is developing a high frequency irreversible electroporation (H-FIRE) platform. H-FIRE improves patient safety by eliminating unwanted muscle contraction that appear in standard IRE treatments [3]. Additionally, H-FIRE has been shown to produce more predictable lesions when compared to traditional IRE treatments. Both techniques consist of a series of short electric pulses that cause nanoscale defects to form in the lipid bilayer, eventually leading to cell death. To date, very little data about the physics and biological effects of H-FIRE at the tissue level has been collected. Through the implementation of a unique passive monitoring system the relationship between IRE and H-FIRE has been further delineated in this study. There are several hypotheses about how H-FIRE will affect tissue differently, but the electric field thresholds for cell death can be studied using potatoes as tissue platforms. Our results show that H-FIRE requires a greater amount of energy to create IRE-equivalent lesions. However, H-FIRE treatments resulted in more uniform ablation volumes. The data produced by this study allows for a more direct understanding of the industry standard and the benefits of the next generation of IRE treatment.

42. Lindsey J Boyle

Dispersal of a defensive symbiont depends on contact between hosts, host size, and resource availability

By dispersing to new hosts, ectosymbionts may escape the sub-optimal fitness conditions imposed by environments with low resource availability, strong intraspecific competition, or low mate availability and inbreeding. Symbionts may balance dispersal risks with fitness benefits by waiting to disperse until risks are low and by dispersing to hosts with the best resources. In a series of six laboratory experiments, we explored the dispersal ecology of a symbiotic annelid Chaetogaster limnaei limnaei that lives on freshwater snail hosts. We discovered that Chaetogaster only dispersed from one snail host to another if the two hosts could directly contact or if the current host died. When snails could contact, Chaetogaster dispersal rates were higher from large snails to small than from small snails to large. Finally, dispersal rates were lower from snails with poor resource conditions to snails with high resource conditions than they were from low to high resource snails. Together, these experiments show that defensive symbiont dispersal behaviors were intricately tied to the ecology of the host organism

Mentor(s): Jeremy Wojdak

43. Janelle Pena, Roberto Reyes Maldonado

Exploring chytrid infection and the skin microbiome of a generalist Puerto Rican frog along an elevational and land use gradient

Recent studies have reported that the microbiome associated with amphibian skin could play a role in preventing or reducing infection by the amphibian chytrid fungus (Batrachochytrium dendrobatidis, or Bd). Since little is known about the microbiome of the Puerto Rican frog, Eleutherodactylus coqui, which is vulnerable to Bd, our aim in this study was to characterize its skin microbiome. We sampled a total of 77 individuals along an elevational gradient on the northeastern face of Sierra Luquillo, Puerto Rico (0-1200m). Our sites encompassed both pristine and disturbed habitat types. In general, we expect to find differences in Bd infection levels and the abundance and diversity of skin bacterial communities across elevations and between habitat types. Specifically, we hypothesized that above 600 meters we would find higher Bd infection intensities on individuals and less diverse bacterial communities in comparison to low elevation sites. Additionally, we hypothesized that in forested areas we would find higher diversity of bacteria and lower levels of Bd infection relative to more disturbed habitats. This study will inform our understanding of the bacteria that inhabit the skin of E. coqui frogs and contribute to our knowledge of the ecological drivers of Bd infection in amphibians.

Mentor(s): Dr. Lisa Belden

44. Zach J Gajewski

The Effect of Zooplankton Feeding on the Amphibian Chytrid Fungus

In recent decades amphibian populations haves declined dramatically. Many of these declines are linked to Batrachochytrium dendrobatidis (Bd), a pathogenic fungus that grows on the skin of amphibians. Recent studies have demonstrated that the zooplankton, Daphnia magna, can reduce mortality of amphibians by grazing on Bd zoospores that would otherwise settle on and infect amphibian skin. If zooplankton consume Bd zoospores as a food source, then zooplankton may potentially be used to control Bd densities in the environment. In this study, we examined if three additional species of zooplankton--copepods (Cyclops), Daphnia ambigua, and ostracods—also consume Bd. Dapnia magna was included as a positive control. A known concentration of zoospores was added into vials containing one of three densities (0, 5, and 10) of zooplankton. The grazing time for all treatments was 24 hours and samples were taken at 0, 12, and 24 hours. To quantify the Bd, a sample of water from each vial was taken at each timepoint, and then quantitative PCR was used to quantify the amount of zoospores in each vial. The samples were then compared to the control to see if the zooplankton reduced the zoospore concentration. This experiment tested the ability of new zooplankton species to consume Bd zoospores and may provide insight into controlling Bd densities in the environment.

Mentor(s): Dr. Lisa Belden

45. Steven Shipp

Elucidating the anorexigenic central mechanism of adrenocorticotropic hormone in chicks (Gallus gallus)

Adrenocorticotropic hormone (ACTH) is most well-known for its involvement in an organism's stress response. Exogenous ACTH also decreases food intake in rats. However, its mechanism is not well understood and has not been reported in birds. Thus the present study was designed to evaluate ACTH's effect on chick food intake and to elucidate the mechanism. Chicks receiving intracerebroventricular (ICV) injection of 1, 2, and 4 nmol of ACTH reduced food and water intake, under both ad libitum and fasted conditions. Following 2 nmol ACTH injection, c-Fos immunoreactivity was quantified in appetite-associated hypothalamic nuclei including the ventromedial hypothalamus (VMH), dorsomedial hypothalamus, lateral hypothalamus, arcuate nucleus and paraventricular nucleus. ACTH-injected chicks had increased c-Fos immunoreactivity in the VMH. Hypothalamus was collected and real-time PCR performed to measure mRNA abundance of some appetite-associated factors. Quantities of neuropeptide Y, pro-opiomelanocortin, glutamate decarboxylase 1, melanocortin receptor 4, and urocortin 3 mRNA were not affected by ACTH. However, expression of corticotrophin releasing factor (CRF), urotensin 2 (UT2), agouti-related peptide (AgRP), and orexin (ORX) mRNA decreased in the hypothalamus of ACTH-injected chicks relative to vehicle-injected chicks. ICV ACTH causes decreased food intake in chicks, and is associated with VMH activation, and a decrease in hypothalamic mRNA abundance of CRF, UT2, AgRP and ORX.

Mentor(s): Dr. Mark A. Cline

46. Alexandra Z Gobeler

Development of an Energy Absorbing Seat in an Army Vehicle Utilizing Brass Tubes

Test were conducted to help develop an energy absorbing seat concept to be used in army combat vehicles. Impacts in a combat situation are typically due to explosions from under the vehicle pushing upward, and can thus cause pelvic and spinal injuries. By developing an energy absorbing seat, injuries can be reduced in those areas, and the survivability of the crew in the military vehicle is improved. In this experiment, brass tubes were examined for their energy absorbing capabilities, and material modeling was done to examine the deflection of radially compressed brass tubes due to a given load. The basic material properties of the tubes were obtained using an MTS to provide the required model parameters. Brass tubes of various diameters and lengths were compressed in various combinations using the MTS to determine their energy absorbing characteristics. The data collected were used to generate load-deflection curves, and were compared to the material modeling curves. Drop testing was conducted to test the dynamic capabilities of the energy absorbing seat concept. Brass tubes have the advantages of repeatability, configurability, low cost, simplicity, corrosion resistance, and multi-direction performance.

Mentor(s): Dr. Warren Hardy

47. Rachel L Warnock

Understanding parasitic weed germination by silencing key genes in strigolactone signaling

Phelipanche aegyptiaca is a root holoparasite that decimates crops in the Mediterranean and Middle East regions. Because of its obligate nature and complete dependence on attachment to a host, this parasite must receive a signal molecule from the host to ensure close proximity to a host plant in order to germinate.1 The signal recognized by P. aegyptiaca is a strigolactone, which is produced to influence root and shoot branching, and to recruit mycorrhizal fungi.2 Perception of a strigolactone occurs when a protein complex in P. aegyptiaca binds to this compound. However, strigolactones are ubiquitous in plants, and P. aegyptiaca also synthesizes endogenous versions of these signal hormones.3 One objective of this project is to study the morphological effects of silencing genes responsible for the parasitic production of strigolactones. The other objective is to discover whether removal of proteins involved in perception of strigolactones would prevent germination. Silencing constructs were generated for key genes using Gateway® technology based on double-stranded RNA interference. The construct was electroporated into Agrobacterium rhizogenes strain MSU440, which mediated the transformation into P. aegyptiaca.4 Over the course of the next year, this project will assess the effects of silencing these genes on parasite seed germination.

Mentor(s): Dr. James Westwood

48. Thomas Collins

Sensory feedback and the effects on synchronous running in groups.

Previous research studied different situations where pairs of walkers will tend to synchronize their gaits while walking. In the present work, our objective is to study how the steps of a group of three runners may synchronize, if one runner (pinner) is provided with music of specific beat frequency, and the two other runners (pinned runners) do not have so. The goal of the experiment is to test whether the pinner be able to bring the pinned runners into synchronization at a gait frequency different than when there is no stimulus provided. The subjects will neither be instructed regarding the research, nor be aware of who is the pinner in the group. The beats are chosen based on average running frequencies, which range from 156 to 168 beats per minute (BPM). Tests will be run with a stimulus whose beat is 156-10% BPM and 168+10% BPM, to study how it affects the group synchronization. Data are collected using a 3-axis accelerometer as the runners are running. Data is logged for 10 minute intervals for each of the three runners, and will be analyzed to find when runners are either stepping in phase or out of phase. Different runners will be chosen for test replicates. The results we hypothesize are that the runners in group with a pinner will get synchronized faster and stay pinned for longer time.

Mentor(s): Dr. Abaid

Oral Presentations Session 2 10:00-12:00

Alexandria Robinson

The effects of shock-wave blasts on the endocrine system

In recent years blast specific traumatic brain injury (bTBI) has become a more prevalent injury within our military personnel. With the increased use of explosive devices along with improvements in body armor, soldiers are surviving blasts that in the past would kill them. However, there are many other side-effects, including bTBI. Research has not yet uncovered the mechanism of injury from bTBI, but results have shown that damage can be drastic. This study focuses on how the blast wave effects the endocrine system specifically the hypothalamic pituitary adrenal (HPA) axis. The HPA axis is the main regulator of hormone production in the body, which when affected by bTBI and has been observed to cause hormone dysfunction. Enzyme-Linked Immunosorbent Assay (ELISA) and Polymerase Chain Reaction (PCR) were used to test the level and expression of Glial-Fibrillary Acidic Protein (GFAP), Leptin, and Adiponectin. The ELISAs were run using serum collected from laboratory rats two weeks after a blast event at 10, 17, and 23 PSI and un-blasted sham samples. The PCRs were run using cDNA extracted from adipose tissue collected from the same animals as the serum collection. The levels of these pituitary linked hormone/proteins will indicate how the pituitary is functioning after damage. The results have shown a defined increase from sham in all of the hormone/proteins tested, with elevations varying with blast pressure exposure. This suggests an over-active pituitary gland, most prevalent at the 10 PSI range.

Mentor(s): Dr. Pam VandeVord

Diego De La Torre Campos

Blast induced traumatic brain injury and the effects of DNA on methylation

Blast-induced traumatic brain injuries (bTBI) account for a significant amount of traumatic brain injury (TBI) cases found in soldiers, with additional injuries involving a combination of blast with vehicular accidents and/or falls, among others. Blast waves cause various internal responses within the body, but the exact mechanics of how the shock wave travels through the head and damages the brain are not fully understood. TBIs resulting from blast exposure are profound and widespread, including cellular dysfunction, atrophy and aberrant epigenetic gene expression. DNA methylation is an epigenetic tool used in regulating gene expression and has been shown to influence normal neuroplasticity, learning and memory. The hippocampus and prefrontal cortex contribute significantly to these functions. Therefore, the aim of this work is to elucidate changes in the methylation status of DNA and the enzymes controlling DNA methylation following bTBIs. To do so, global methylation levels were measured in the hippocampus and prefrontal cortex of rats subject to a blast injury. Various blast overpressures (10, 17, 23 psi) and various time points following injury (1 week, 2 weeks) were investigated. Using RTPCR, significant changes in levels of DNMT enzymes, DNMT1 and DNMT3b, were found in the hippocampus, while the prefrontal cortex exhibited no significant changes, which suggests that these enzymes may contribute to altered DNA methylation following injury. Global DNA methylation will be investigated using a commercial kit. It is hypothesized that changes in DNMT1 and DNMT3b expression will correlate with altered DNA methylation states, which may play a critical role in the response and recovery following bTBIs.

Mentor(s): Dr. Pam VandeVord

Iriat Faisal

Irreversible Electroporation of Bacteria in Suspension

Irreversible Electroporation is a technique used towards cancer treatment in order to create pores in a cell membrane that do not close, eventually killing off the cell. An electrical pulse is generated in the cell membrane, leading to the pore formation due to an applied electric field that alters the transmembrane potential. The electric pulses are mimicked in a biomaterial to determine the best distance-to-voltage ratio that causes IRE. The biomaterial used, bacterial cellulose, is ideal due to its biocompatibility and mechanical integrity. The bacteria used in this experiment, Gluconacetobacter Xylnius, was used to create bacterial cellulose by placing it in water. The bacterium swims in the media and expels cellulose as the bacteria moves. After about a week, a pellicle formed and the pellicle is removed and the new media is split to make more bacterial cellulose. The cellulose creates a dense network of fibers when it is in static culture and is left undisturbed. These fibers mimic the bone, making it an ideal biomaterial for bone scaffolding. . If IRE is used to kill bacteria at specific time points and specific places, pores or holes in the fiber are created. To determine the threshold to cause IRE, the voltage-to-distance ratio is altered in order to predict pore sizes in the cellulose network. From this threshold, IRE is then used to create a bone scaffold.

Mentor(s): Dr. Rafael Davalos and Adwoa Baah-Dwomoh

Tiara McDonald

Polyether ether ketone (PEEK) matrix reinforced composites

The purpose of this study was to generate polymer matrix reinforced composites consisting of nano carbon particles and the polymer Polyether Ether Ketone (PEEK) with the mixing technique of mechanical alloying. The polymer PEEK was mixed with 35 hour SPEX milled graphite that was divided into five different weight percent categories; 1%, 5%, 10%, 20%, and 30% with a 1.5 charge ratio. The two metal balls used for mechanical alloying of the two powders, combined weighed 16.42 grams while the total mass for the powders inside of the vials was 10.94 grams. Two samples for each weight percent was mixed so each sample could be milled for five hours and then another sample for ten hours. The weights for the graphite for 1%, 5%, 10%, 20%, and 30% were 0.109 grams, 0.547grams, 1.094 grams, 2.188 grams, and 3.282 grams respectively. The atomic and molecular arrangements of the milled PEEK samples were observed by X-ray diffraction that displayed a large number of scattered waves. The change of the samples' heat capacity by temperature was then recorded by Differential Scanning Calorimetry (DSC) analysis. For the DSC analysis of PEEK, the 2D linear graphs indicated two dips, the first one indicating the glass temperature and the larger dip indicating the melting point of PEEK. The specimen with the most PEEK composition and longer milling time, 1wt% at ten hours, had the largest dips displayed on the graph because of the physical properties of PEEK when compared to the other specimens.

Mentor(s): Dr. Alex Aning

Alex Newman

Ultra high Molecular weight polyethylene (polymer matrix)

Ultra-high-molecular-weight polyethylene (UHMWPE) is a type of thermoplastic polyethylene. Composite materials are made up of two or more materials on a macroscopic scale. A Polymer matrix is comprised of plastics within which contain structured fibers known as the reinforcement. Various tests were used in order to determine the strongest version of the material. First, in order to reduce the particle size as and make a more homogenous mixture, the polymer was mixed with Graphite that was milled for 35 hours through the process of mechanical alloying. Multiple samples were mixed in weight percentages that include 1%, 5%, 10%, 20%, and 30%. The milling was achieved by weighing out a calculated amount of each sample and placed in a metal jar along with two metal balls. The samples were then placed in a machine at intervals of 5 and 10 hours at a time. The UHMPWE mixture was then casted into sheets by collecting approximately 8 grams of the material and molded using the Dake Heat Press machine. In order to get a satisfactory sheet, a heating time of 40 minutes at 3psi was necessary in addition to letting the sheet cool. X-ray diffraction techniques were then used in order to examine the atomic as well as molecular arrangement of the samples. In addition, Differential Scanning Calormetry (DSC) was then used to test how the material's heat capacity (Cp) is changed in relation to temperature. The data, shown through a graph, includes two dipping points that indicates glass temperature and melting points respectively. Finally, cutting the sheets by means of a Tensile test was need to measure the strength of the material. It was predicted that increasing the weight percentage in concert with the higher heating time (10 hours) would result in the strongest and sturdiest version of the polymer matrix.

Mentor(s): Dr. Alex Aning

Christopher Owusu-Sampah

Olivine chemical analysis and Raman spectroscopy

The analysis and utilization of olivine is advantageous to the geosciences, as it provides valuable information of the source and evolution of magmas. Olivine (Fe, Mg)2SiO4 serves a multitude of purposes, from taking a chemical "snap-shot" of a magma chamber, called a melt inclusion, to measuring how hot the magma was at particular stages, known as a geothermometer. Due to its importance, it is of prime concern to develop quick, accurate, and non-destructive methods of analysis. The standard method uses an Electron Microprobe (EMP) to determine olivine's major elements (Si, Fe, Mg). The information obtained from the microprobe is used to calculate the modal Mg-number (Mg#=MgO/(MgO+FeO)), a value that determines the state of evolution of the magma that crystalized the olivine. However, a potential alternative to Electron Microprobe analyses for the determination of Mg# is Laser Raman Spectroscopy. Instead of bombarding electrons at the sample and looking at the respective x-rays, the Raman spectrometer uses the Raman scattering effect to observe the vibrational modes of the molecules comprising the olivine. After fitting a Lorentzian curve to each resulting wavelength peak, recorded on a Raman shift vs. intensity graph, the peak intensity varies linearly with Mg#. Because a laser is used, however, factors such as light polarization, intensity, and rotation must be accounted for in Raman analysis. Our goal is to calibrate the Raman technique to produce the same level of accuracy as with the EMP but with a higher efficiency.

Mentor(s): Dr. Esteban Gazel

Crystal Davis

Neural anatomy of human color preference

By using data from functional magnetic resonance imaging in conjunction with data from a behavioral study, the goal of this research is to understand the physiological basis of color perception in regards to preference. Participants of this study were shown 8 different circles of color, as well as circles of gray, as the control, while being scanned in fMRI. Colors chosen were equal in saturation and lightness, with hue being the only variable, and were equal distances apart on the CIE LUV color space. It is anticipated that neural activity when viewing preferred colors will be different from neural activity when viewing unpreferred colors. The behavioral portion of the study had participants view each possible color pair and rate which of the two they preferred, providing implicit color preference data. Participants were then asked to overtly state their preferred color. Analysis of behavioral data will focus on differences and similarities between the implicit and overt responses in order to further contemplate whether overt responses of color perception are dependable.

Mentor(s): Dr. Anthony Cate

Abbey Hammell

A multimethod examination of attention in middle childhood: Frontal EEG and maternal report

Attention acts as a catalyst for our goals by selecting and prioritizing information necessary for everyday life. Posner and colleagues developed a theory of three attention networks: alerting, orienting, and executive attention. These three networks involve different brain systems, but also work together and are functionally mature by middle childhood. Parent rating scales are traditionally used to assess children's attentional behaviors. However, little neuropsychology research has been done to examine the neural and behavioral validity of these questionnaires. Seventy local community children (ages 9-11) from an ongoing longitudinal study participated. During the lab visit, children wore an EEG cap while performing the Attention Network Test (ANT). Mothers also completed behavioral-rating scales: the Child Behavior Checklist (CBCL) and the Early Adolescent Temperament Questionnaire (EATQ). We examined the attention-problems scale of the CBCL and the attention scale of the EATQ. Regression analyses demonstrated that task-related changes in frontal EEG and maternal ratings on the EATQ uniquely predicted alerting, but not orienting or executive attention. The CBCL, a measure of attention problems, did not predict ANT scores or EEG activity. This study demonstrates the value of a multi-method approach to studying attention. Furthermore, it suggests that future investigations need to focus on the predictive power of the CBCL in a community sample.

Mentor(s): Dr. Martha Ann Bell

Emily Blair

The universal redneck: Representations of rednecks and hillbillies in contemporary country music

Ever since local color writers at the turn of the 20th century crafted the falsehood of the Appalachian "Other" in America, Appalachians and Southerners alike have dealt with the largely negative stereotypes evoked by the words "hillbilly" and "redneck." This study focuses on the contemporary use of the terms "redneck" and "hillbilly" in popular country music in the past five years. Of the 181 songs that reached the #1 position on the Billboard charts in either "Hot Country Songs" or "Country Airplay," four included the aforementioned terms, just over two percent of the total. This study analyzes three of those songs: "Boys 'Round Here" and "Hillbilly Bone" by Blake Shelton, and "Country Must Be Country Wide" by Brantley Gilbert. By examining the contexts of the terms hillbilly and redneck within each song, as well as the images and actions associated with the terms in the music videos, the researcher found some similarities among the songs. First, each song attempts to universalize "rednecks" or "hillbillies" to include individuals outside of the geographic, racial, and class boundaries that have been traditionally associated with these terms. Secondly, the songs redefine these terms from a largely racist and exclusionary past to a more diverse, inclusive group of like-minded individuals. This study raises questions about the implications of these redefinitions and suggests directions for further research.

Mentor(s): Dr. Betty Fine

Kathryn Dunn

Small towns in transition: A green infrastructure approach

The original purpose of this research was to examine the concept of shrinking cities and vacancy through different scales from larger cities to small towns, and how interventions such as green infrastructure could help mitigate the amount of perceived vacancy. Case studies such as Cleveland, OH, New Orleans, LA, and Philadelphia, PA, were examined to show how these places have used green infrastructure approaches and how smaller towns, such as Christiansburg, VA, can put forth new strategies similar to those used in larger contexts. However, reviewing the literature related to shrinking cities, as well as analyzing Christiansburg's demographics and population trends, the current definitions for shrinking cities does not lend itself to smaller towns. Christiansburg, a small town located in the Blue Ridge Mountains of Virginia, is growing in population; yet, its downtown area along Main Street is currently suffering from a loss of businesses and increase in unoccupied building space. This current shift, in turn, has had a negative impact on the perception of downtown Christiansburg's spatial qualities, social interactions, and economic development. The question remains, is downtown Christiansburg truly vacant, according to traditional definitions of the term? How can interventions such as green infrastructure change the community's perception of vacancy from a negative view into a positive opportunity? By examining transportation and commercial development patterns, and analyzing historical maps of Christiansburg, one can speculate that this idea of vacancy is not permanent, but rather temporal. This is turn could change the way Christiansburg residents view vacancy, and could shift the way citizens think about where they live, and potentially develop a new theoretical framework that are in not necessarily focused on shrinking, but shifting.

Mentor(s): Brian Katen and CL Bohannon

Solmaz Eskandarinezhad

Study of Nitrogen Fixing Bacterial Communities in two ecotypes of Switchgrass, Alamo and Dacotah

Increasing global demand for fuel has catalyzed research to produce alternative renewable fuels. The growth of feedstock, such as Switchgrass, can help toward this goal because they produce high yields, are environmentally adaptable, and can potentially grow well on low fertility lands. In particular, nitrogen fixation associated with feedstock grasses such as Switchgrass could further help these biofuel grasses grow sustainably over many decades. The ability to utilize and improve upon the natural nitrogen fixing system in Switchgrass will serve to increase this source of biofuel and the world's energy needs. Two ecotypes of Switchgrass, Alamo and Dacotah, adapted to different environments and having different growth rates were chosen to test the hypothesis that the former has greater nitrogenase than the latter. These two cultivars were studied during early plant growth to assess bacterial nitrogenase activities in the. DNA based molecular gene assays (16S rRNA) showed a tendency for different cultivable bacterial communities in the rhizosphere, however, rates of nitrogenase at this early growth stage where low and not different between Switchgrass cultivars. The results suggest communities in the two ecotypes differentiate early following germination. It is speculated that plant N demand during this time is also low and thus explain the low rates. It is hypothesized that as the plants continue to grow and demand for nitrogen increases, that greater nitrogen-fixing activity will be measured in Alamo. The extents to which different bacterial communities contribute to this difference, if further confirmed, are expected.

Mentor(s): Dr. Mark Williams

Bishal Paudel

Selected gene expression in response to iron deficiency in potatoes

Potato (Solanum tuberosum) is an important food crop not only because it is a good source of carbohydrates, proteins, and vitamin C, but also due to the fact that it is an intriguing source of micronutrients such as iron and zinc. The purpose of this study was to improve the micronutrient component of potato tubers by understanding how genes respond to iron deficiency in the nutrient media. We used a tissue culture system to grow homozygous potatoes in order to observe possible differences in gene expression for genes that are responsible for iron acquisition from the media. A number of candidate genes were found to be up-regulated in the potato cultivars grown in the iron deficient media compared to the potato cultivars grown in normal iron supplemented media. We expect that the difference in gene expression among cultivars is associated with differences in the nucleotide code of the single alleles per gene within each cultivar. Potato plants with superior alleles at these loci may be expected to have an advantage in acquiring micronutrients from deficient soils. The results from this study will help in the biofortification of potatoes via gene editing, which will eventually benefit the human population, especially in regions where populations subsist on potato varieties that are currently deficient in micronutrients.

Mentor(s): Dr. Richard Vellieux

Michael Sibilo

Analysis of fungal bacterial abundance along chronosequence soil

Microbial communities and plants are major drivers of soil and ecosystem development, however, little research has been conducted to assess how they change and possibly feedback as part of the ecosystem-building process. Linkages between plant diversity and microbial communities may ultimately determine ecosystem functioning, for example. Samples were collected from a soil chronosequence in Wilderness Park, Michigan, from soils between 105 and ~4000 y since deposition and the start of soil pedogenesis. The purpose of this experiment was to characterize bacterial and fungal abundance changes resulting from changes in season and soil-ecosystem development. Changes in fungi and bacterial communities are a key part of a changing ecosystem and can provide clues to the dynamic process of soil development and soil function. Microbial abundance was measured using quantitative PCR (qPCR) of bacterial and fungal rRNA genes. qPCR was successfully used to determine the abundance of bacterial gene numbers, however, no differences were detected as a result of soil development. Fungal gene abundances are currently being collected. It is hypothesized that fungal to bacterial ratios will increase during soil and ecosystem development. The implications of this research are the ability to determine how ecosystems naturally develop and change and ways that plant, soils, and microbes co-develop to create ecosystems. If confirmed, the community change will be further investigated to understand its effects on ecosystem function and development.

Mentor(s): Dr. Mark Williams

Chelsea Horton

Investigation of canine fecal lactoferrin as a biomarker for intestinal inflammation in dogs

Inflammatory Bowel Disease is a common disease affecting dogs. In human studies, a glycoprotein called lactoferrin is directly correlated with the severity of inflammation in the intestines. The Purpose of this study was to determine if canine fecal lactoferrin concentration varied between Giardia infected and uninfected dogs as determined by Meridian Merifluor and Zinc Sulfate results. Stool samples were collected from 100 (58 infected, 42 uninfected) dogs. Samples were randomized and lactorferrin was measured using a customized quantitative enzyme linked immunosorbant assay (ELISA). Median canine fecal lactorferrin concentration was significantly higher (P-value < 0.0001, Mann Whitney) in Giardia infected dogs (8.79 µg/ml) than in uninfected dogs (0 µg/ml). Canine fecal lactoferrin did not correlate with the number of Giardia cysts but median concentrations were significantly different when comparing fecal consistency scores (Kruskal-Wallis, P < 0.0198). Increased fecal lactoferrin appears to be associated with Giardia infections in dogs. These findings suggest canine fecal lactoferrin may serve as a biomarker for intestinal inflammation. In future studies this analyte may prove useful in distinguishing between inflammatory and neoplastic intestinal disorders in dogs.

Mentor(s): Dr. Tanya LeRoith

Josef Mang

The effect of PDL-1 upregulation on the swine immune system in PCV2

Porcine circovirus-associated disease (PCVAD) is a globally-encompassing disease that has been found to infect the majority of the world's pigs. PCVAD is the blanket term given to a collection of syndromes resulting from infection of porcine circovirus type 2 (PCV2), which is one of leading causes of mortality and loss of value of swine livestock in swine-related industry. One of the characteristics of PCVAD is the depletion of the host's lymphocyte count, which contributes to the downward spiral that is an immune system that cannot recover. One particular gene, PDL-1, is a key member of a signaling pathway that induces cellular death on lymphocytes and is thought to be upregulated during PCVAD. Results have shown that inflammatory response to PCV2 infection is thrown out of balance as intrinsic genomic sequences of PCV2 suppress select cytokine secretions. This imbalance of antiviral response could possibly upregulate PDL-1 expression, effectively depleting lymphocytes. Interleukin-6 (IL-6) is one such cytokine that has been shown to be vital to the upregulation of PDL-1, and during PCV2 infection, IL-6 is one of the few cytokines that is still expressed. In conclusion, this review points to the possibility that PCV2 infection, culminating in PCVAD, may stimulate the formation of lymphocyte depleted lesions as a result of upregulating PDL-1.

Mentor(s): Tanya LeRoith

Kevin Arnold

Analysis of the membrane binding properties of INPP4B

Inositol polyphosphate phosphatase 4 B (INPP4B) is a recently discovered protein that has tumor suppressor properties. Using its catalytic domain, INPP4B dephosphorylates the four position phosphate on the inositol ring of phosphatidylinositol 3, 4-bisphosphate (PtdIns(3,4)P2) as part of the PI3K pathway. If left phosphorylated, PtdIns(3,4)P2 will activate the Akt causing cell growth, motility, and proliferation which left unrestricted leads to tumor formation. Studies found the PI3K/Akt pathway is defective in many human cancers. Furthermore, it has been found that INPP4B is missing or defective in 84% of human breast cancers. The purpose of this study was to examine both the ability of INPP4B and its C2 domain to bind phospholipids. While it is possible use bacteria to overexpress the full length protein, as evidenced by previous studies, some difficulties were encountered. Cultures of E. coli (Rosetta strain) were induced at different experimental conditions without success. Instead a different strain, BL21, was used for the full length INPP4B. Its C2 domain was successfully purified and its membrane binding was tested using the lipid protein overlay assay. The results showed that the protein strongly binds to PtdIns(4,5)P2 and weakly to phosphatidic acid (PA). This differed from previous studies which showed strong binding to PA and PtdIns(3,4,5)P3 and weak binding to other phosphoinositides. This result suggests that INPP4B anchors the plasma membrane through PtdIns(4,5)P2 and allows the protein to precisely catalyze the dephosphorylation of PtdIns(3,4)P2 via its catalytic domain. Understanding how INPP4B binds to the membrane and how that affects its function allows for a better understand of cancer and creates the potential for new treatments.

Mentor(s): Dr. Daniel Capelluto

Floricel Gonzalez

Identifying genes enabling bacteriophage 7-7-1 resistance in Agrobacterium sp. H13-3 via transposon mutagenesis

The host range of bacteriophage 7-7-1 is exclusive to Agrobacterium sp. H13-3. Bacteriophage 7-7-1 attaches to the rotating flagella of Agrobacterium sp. H13-3 and is believed to make its way down the flagella via a nut and bolt mechanism. Once at the flagella base, phage 7-7-1 is able to interact with cell surface receptors and inject its DNA into the bacterial cell. Lysis of the infected bacterial cell allows the phage to propagate and continue to infect other bacterial cells. However, past research has found that phage 7-7-1 cannot infect non-motile Agrobacterium sp. H13-3 due to the absence of flagellar rotation. The location of the mutations within the Agrobacterium sp. H13-3 genome that enable bacteriophage 7-7-1 resistance have not yet been identified. The purpose of this study is to locate non-motile and motile phage resistant Agrobacterium sp. H13-3 mutants. These mutants will be identified via a screening of 1000 colonies that have been selected for Transposon insertion. Additionally, "transposon-specific sequencing" will allow pinpointing of the genetic variations enabling phage 7-7-1 resistance within non-motile and motile mutants. A bioinformatics analysis of the transposon insertion sites within the non-motile and motile mutants will be provided.

Mentor(s): Dr. Birgit E. Scharf

Diana Pham

Studies on matrix stiffness and cell malignant morphology with constructed three-dimensional mammary tissues

The increased stiffness of the extracellular matrix (ECM) promotes malignant behavior of cells by clustering integrins. This clustering causes an increase in Rho activity that disrupts the normal homeostasis of a cell. Previously used two-dimensional cultures were shown to intensify this issue with their rigid substrata so more cultures with compliant three-dimensional ECM are used. The aim of this study is to extend these three-dimensional cultures to include a vascular system to test the effects of ECM stiffness on the phenotype of mammary epithelial cells. The effect of matrix stiffness on cell morphology is therefore examined in a more realistic representation of the in vivo environment for cells. The procedure for creating the 3D ECM is still in progress. It essentially involves printing a 3D carbohydrate structure that is used as a temporary structure. The carbohydrate structure is coated in polymer poly(d-lactide-co-glycolide) (PDLGA). When this structure is put into a mixture of collagen and cell media, the carbohydrate lattice in the structure dissolves, leaving the PDLGA as channels for flow of nutrients and other necessary substances while encasing it in a collagen ECM. The concentration of collagen can then be varied within the ECM to resemble different ECM stiffness. This study provides a way to examine how the ECM stiffness affects the morphology and malignancy of cells with a vascular system to further understand how mammary cells can undergo tumor formation and metastasis.

Mentor(s): Dr. Carla Finkielstein

Juliana Pham

Studies on the regulation of Endosome-Associated FYVE-domain binding to phosphatidylinositol 3-phosphate

Endosome-Associated FYVE-domain protein (Endofin) is an adaptor protein that plays a role in membrane trafficking, in which cargo is transported to its designated location. Its FYVE (Fab1p, YOTB, Vac1p, EEA1) domain binds specifically to phosphatidylinositol 3-phosphate (PtdIns(3)P), and this association allows the protein to localize to early endosomes. To better understand how Endofin is regulated, the lipid binding will be tested in the presence of TOM1 to determine if TOM1 modulates the binding. Since TOM1 modulates Tollip activity, it is a good candidate for the regulation of Endofin binding to PtdIns(3)P. SDS-PAGE analysis demonstrated that the GST-fusion Endofin FYVE domain has been purified to homogeneity. Lipid-protein Overlay Assay established binding between GST-fusion endofin FYVE and PtdIns(3)P, phosphatidylethanolamine (PE), and phosphatidic acid (PA). The purification of full-length Endofin and the effect of TOM1 in Endofin's lipid binding are currently in progress. We seek to establish whether TOM1 modulates lipid binding to predict TOM1-mediated common modulation principles.

Mentor(s): Dr. Daniel Capelluto

Cedric Revell

Inhibition of the microtubule depolymerase Kif2a in PtK1 cells increases the stability of kinetochore-bound microtubules

Cell division or mitosis is the process by which each cell generates two genetically identical daughter cells. Errors in the transmission of DNA are at the base of cancer development and progression. Accurate chromosome segregation is ensured by proper interaction between the microtubules (MTs) of the mitotic spindle and the kinetochores, specialized protein structures that assemble on each chromosome at the level of the centromere. During metaphase, each chromosome aligns at the cell equator and maintains dynamic attachments to spindle MTs. Net addition of tubulin subunits at the microtubule plus-ends, which are attached to kinetochores, is balanced by persistent microtubule minus- end depolymerization at the spindle pole. MT dynamics and the activity of motor and non-motor proteins cooperate to modulate chromosome movements during metaphase and to ensure maintenance of proper KT-MT attachments. Kif2a is the major depolymerase responsible for depolymerization of tubulin at MT minus ends at the spindle poles. We asked whether inhibition of Kif2a, and hence suppression of MT minus end depolymerization, would affect the stability of MT plus ends, thus increasing the number of KT-bound MTs. We inhibited Kif2a by injecting an anti-Kif2a function-blocking antibody in live mitotic PtK1 cells, we then fixed and immunostained such cells, and finally measured the fluorescence intensity of KT-bound MT bundles. Our results indicate that Kif2a inhibition increases the number of MTs attached to KTs, possibly reflecting an increased stabilization of KT-MT attachments.

Mentor(s): Dr. Daniela Cimini

Crystal Smitherman

Antibiotic resistant genes in dairy cow soil samples

Antibiotic usage by the dairy industry is known to result in high levels of antibiotic resistance in the animal. However, little is known about how this resistance is transferred to agricultural soils via manure inputs or how the function of soil microbial communities might be affected. Exposure of soil microorganisms to these antibiotics or antibiotic resistance genes (ARGs) can decrease microbial growth and increase demands for maintenance, possibly leading to changes in the soil microbial community and how these communities regulate carbon, nitrogen, and phosphorous cycling. The goal of this research was to determine if increased exposure to dairy manure inputs results in increased prevalence of ARGs in soil microbial communities. Paired soil samples from eleven different dairy research farms that compared high and low dairy manure inputs were analyzed for concentrations of ARGs. Specifically, quantitative PCR was used to quantify copies of ARGs for resistance to tetracycline (tetO and tetW), erythromycin (ermB), and cephalosporin (ampC), as well as total numbers of bacteria and fungi. Little change is expected in tetO, tetW, or ermB because tetracycline resistance is naturally abundant, while erythromycin is not naturally abundant, nor is it used regularly in the dairy industry. In contrast, cephalosporin is not naturally abundant but is commonly used therapeutically in the dairy industry, so the greatest difference in ARG concentrations is expected for ampC.

Mentor(s): Dr. Brian Badgley

Francis DeBenedictis

Perilipin 2's role in lipid storage mechanisms for skeletal muscle

The presence and advantage of body's need to tightly regulate energy expenditure and mediate the usage of energy within the cell to only the absolutely necessary level is evidenced by the presence of intracellular energy storage in the form of lipid droplets. This means creation, maintenance, and utilization of lipid droplets within skeletal muscle represents an important metabolic pathway, the dysfunction of which could be involved in the development of insulin resistance and disease such as type 2 diabetes. These intracellular lipid droplets are contained within a primary phospholipid monolayer with a host of associated proteins of which the perilipin family of proteins plays an integral role in lipogenesis and lipolysis. Perilipin 2 has an active role in lipid droplet storage, specifically protecting the droplet from being utilized improperly or prematurely during muscle exercise. This experiment is designed to determine the relationship between dietary fat intake and its effect on perilipin 2 levels within muscle tissue. If a direct relationship can be determined between perilipin 2, with its function in intercellular lipid storage, and fat intake than it could impact treatment options for insulin resistance and diabetes.

Mentor(s): Dr. Madlyn Frisard

Carolyn Greene

Flavor compound analysis of Horchata de Chufa

Horchata de chufa is a beverage made from a nutsedge (Cyperus esculentus L.), a grass plant that produces tubers, much like peanuts, which is popular in Spain. Horchata may look like soymilk, but horchata has a naturally occurring pleasant, nutty flavor. Studies show that Horchata de Chufa from different geographical locations have different flavor and chemical characteristics (fatty acid profiles), but very little information is available on the compounds present in horchata that contribute to its flavor. The purpose of this study is to identify the volatile flavor compounds that provide the distinct flavor of chufa. Flavor compounds will be isolated by using simultaneous distillation and extraction and solid phase micro extraction and will be identified by using gas chromatography mass spectrometry and gas chromatography olfactometry (using human nose as detector). Possible future implications of this study could include potential for enhancing the quality of Horchata de Chufas, producing horchata flavored confectionery items, and using flavor profiles as geographic markers. A better understanding of the chufa's flavor profile will also aid in marketing the exciting beverage as a product in the United States

Mentor(s): Dr. Sean O'Keefe

Alexander Shimozono

Kinetics of inhibition of anopheles gambiae and human acetylcholinesterase by primary carbamates

Malaria is a mosquito-borne disease that kills over half a million people per year. Currently, there are over 1 billion people at high-risk of malaria infection. In many of these high-risk areas, insecticide-treated nets serve as the primary method of malaria control by killing the vector mosquito. Growing resistance to pyrethroid insecticides used to treat these nets has created interest in the development of new insecticides that possess a different mechanism of action but are sufficiently non-toxic to humans to allow application to nets. Specifically, insecticides that target acetylcholinesterase (AChE) have been proven to be effective methods of control against the African malaria mosquito (Anopheles gambiae) when applied to the upper reaches of interior walls (indoor residual spraying). Two issues that discourage use of these compounds on nets include a low selectivity against human AChE and the rise of an insecticide-resistant An. gambiae strain (G119S). We previously developed a series of aryl carbamates that have shown up to 500-fold selectivity for wild type (WT) An. gambiae AChE over human AChE. These compounds were toxic to susceptible strain An. gambiae, but unfortunately, none were appreciably toxic towards G119S resistant strains of An. gambiae. Recently, the Carlier group has discovered a class of carbamate that is highly toxic to both strains of An. gambiae, even though the molecules do not potently inhibit the resistant enzyme. To investigate the possibility that oxidative metabolism activated these compounds to create effective inhibitors of G119S An. gambiae AChE, we evaluated inhibition of AChE by primary carbamates.

Mentor(s): Dr. Paul Carlier

Gisella Kakoti

Algorithmic Parameterization of a Budding Yeast Cell Model
Gisella Kakoti

The Quasi-Newton Algorithm for Stochastic Optimization (QNSTOP) is a computer algorithm developed for stochastic and deterministic optimization of objective functions that involve uncertainty and random noise. QNSTOP is particularly useful for functions with high dimensionality and numerous local minima. The algorithm has a broad range of applications, such as biomechanics, acoustics, traffic networking, medicine, and aerospace engineering. My research focused on utilizing QNSTOP to predict changes in budding yeast cell cycles. More specifically, I analyzed experimental data on G1 phase duration and the masses of mother and daughter yeast cells before and after cell division. The budding yeast cell model has 143 rate constant parameters, most of which are problematic to calculate directly from experimental results. Usually modelers deduce these parameters through a process called "parameter twiddling," in which they make a series of educated guesses and compare simulation results with experimental data. QNSTOP automates this process and provides better estimates by comparing probability distributions of the simulations to the experimental data. This algorithm can be utilized in future research as a faster and more accurate method of parameterization.

Mentor(s): Dr. Layne Watson

Naomi Butler-Abisror

Influence of the elastic modulus of aligned electrospun fibers on mesenchymal stem cell behavior in collagen gels

Rupture of the anterior cruciate ligament (ACL) is one of the most common injuries of the knee, with over 200,000 patients diagnosed annually. Due to the limitations of current autograft and allograft treatments such as limited donor tissue availability, and poor integration and healing response, alternative treatments such as tissue engineering are being investigated. The objective of this study was to determine whether the orientation, proliferation, and adhesion of mesenchymal stem cells (MSC) to aligned fiber meshes is dependent on substrate mechanical characteristics. Aligned electrospun fibers composed of varying blends of poly(ε-caprolactone) and polyurethane were fabricated and characterized through scanning electron microscopy and monotonic mechanical testing. The fiber diameter, alignment, and elastic modulus of the various blends were compared to determine which materials have distinct properties. Rat MSCs were seeded within collagen gels onto mechanically different meshes and cultured for up to four days. At 6, 24, and 96 hours following seeding, samples were fixed in formaldehyde and stained with rhodamine-phalloidin to visualize the actin cytoskeleton and counter-stained with DAPI to visualize the nuclei. The shape and orientation of the cells were characterized to determine if cell adhesion and alignment to the underlying fiber mesh over time is influenced by its mechanical characteristics. These materials can be used to study how mechanical properties influence mesenchymal stem cell behavior without varying fiber diameter or alignment.

Mentor(s): Dr. Aaron Goldstein

Durga Dahal

Effective cellulose based oral drug delivery systems for the treatment of HIV

Human immunodeficiency virus (HIV) is a virus that damages the immune system and can lead to other life threatening diseases such as neurological problems or AIDS. Due to this prevalent infection of HIV, drug dispersion formulations have been conducted to prevent the inception and spread of the disease as multiple drug combinations, which can be more convenient for patients and more affordable for use in third- world countries. The oral route of drug delivery is a convenient method of administering drug, however most of the HIV drugs are poorly water soluble because of their high hydrophobicity and crystallinity. Thus, to overcome this obstacle, amorphous solid dispersion (ASD) formulation has been implemented to trap the poorly water-soluble drugs in their amorphous forms for the enhancement of dissolution rate and bioavailability. Herein, ASDs were prepared by co-precipitation method with various cellulose derivatives of different hydrophobicities; cellulose acetate suberate (CASub), cellulose acetate propionate adipate (CAAdP), 6-carboxy-cellulose acetate butyrate (CCAB) and carboxymethylcellulose acetate butyrate (CMCAB), in order to increase dissolution rate of ritonavir, etravirine and efavirenz. Amorphous solid-state property of precipitates was shown by X-ray diffraction and dissolution studies, which showed an increment of solubility of three drug combinations at small intestine pH (6.8).

Mentor(s): Dr. Kevin Edgar

Brandon Gulledge

Nonlinear modeling of a bicycle tire in ABAQUS

According to the National Highway Traffic Safety Administration, an average of 699 pedalcyclist (one who operates solely pedal-powered vehicles) fatalities have been reported each year from 2003 to 2012, with the Centers for Disease Control and Prevention estimating 515,000 serious bicycle-related injuries in 2010. Following this fact, it is the engineer's responsibility to be able to appropriately analyze design features of bicycles in order to improve safety and minimize the cost of components. Bicycle tires in particular, are one of the most complex mechanical systems to analyze due to their constitutive behavior resulting from interactions between several material compositions. As such, it is of interest to be able to more effectively model bicycle tires for the purpose of improving cyclist safety and manufacturing efficiency. The models used for tire analysis are typically in the form of computer simulations using the Finite Element Method (FEM) to describe the mechanical behavior seen from tires. This research seeks to use the FE program, ABAQUS, to effectively model a bicycle tire subjected to various loading conditions and use physical testing to determine the constitutive mechanical properties therein. As such, this research stands to improve the safety of cyclists by providing knowledge to the field of bicycle tire design.

Mentor(s): Dr. Rakesh Kapania and Arafat Khan

Poster Session 3 1:30-2:30

1. Samuel J Berk

Membrane Binding Properties of TIRAP

The MyD88 pathway is one of the main mechanisms of innate immunity responses. Toll-interleukin-1 receptor domain-containing adaptor protein (TIRAP) has been shown to be the first event in the Toll-like receptor-2 (TLR-2) and TLR-4 signaling Myeloid differentiation primary response gene 88 (MyD88)-dependent pathways, and it is critical for MyD88 recruitment at the plasma membrane. The mechanism for membrane recruitment of TIRAP has yet to be fully identified. Binding of TIRAP to the phosphoinositides phosphatidylinositol 4,5-biphosphate (PI(4,5)P2) and phosphatidylinositol 3-phosphate (PtdIns3P, through its Phosphoinositide Binding Domain (PBM) was tested using the Lipid Protein Overlay Assay. Key binding residues based on NMR titrations were mutated to alanine in both TIRAP and its PBM peptide, and wild type versions of each along with the key mutants were tested using the same assay. We found that interaction of wild type full-length protein and peptide both interacted strongly with PI(4,5)P2 and PtdIns3P, and were able to decipher which residues were necessary and sufficient for binding. These findings may provide important information as to the mechanism of membrane binding of TIRAP, and an understanding of the first event in the innate immune response.

Mentor(s): Dr. Daniel Capelluto

2. Hayley Billingsley

Health Impacts of Community Supported Agriculture

In the United States, over two thirds of adults are overweight or obese and eighty- six percent do not consume the recommended amount of fruits and vegetables. Community Supported Agriculture (CSA) programs obligate participants to consume weekly deliveries of fresh, local produce which may lead to healthier eating habits. However, the CSA farming model has only existed for about twenty years and relatively little is known about its impacts on personal health and thus many questions can be asked. This study compares the dietary quality of twenty five people who participate in four CSA farms in Virginia's New River Valley to the average American. It also explores people's perceptions of how CSAs' affect their health. Diet quality was quantified through 24-hour dietary recalls measuring caloric consumption, macro- and micro- nutrient composition, servings and variety of vegetables consumed. This data was compared to national averages provided by the National Health and Nutrition Examination Survey (NHANES). The perceived health impacts of CSAs were assessed through participant survey. Overall CSA members consume less saturated fat, more servings of vegetables, a higher proportion of potassium to sodium, and less added sugar than the average American- potentially reducing their risk of diet-related chronic disease.

Mentor(s): Dr. Megan O'Rourke

3. Ben C Coleman

Ovarian cancer spheroid formation as a target for chemoprevention

Ovarian cancer is usually diagnosed after it has spread throughout the peritoneal cavity and formed metastases. Due to this late diagnosis in many women the prognosis is unfavorable. Ovarian cancer forms spheroids that exfoliate from the ovary and travel throughout the peritoneal cavity where they can form more spheroids. These spheroids can recruit other cells as they travel. To test the hypothesis that this may help with the cancer's ability to attach, grow, and invade, in our experiments we used transformed mouse ovarian epithelial cells (MOSE) representing slow and fast developing disease along with cells found in the peritoneal cavity of women with ovarian cancer. Since visceral fat is associated with ovarian cancer progression, we also included the stromal vascular fraction isolated from adipose tissue in our measurements. We explored the impact of these cells on the spheroids ability to attach, grow, and invade, and the response to bioactive sphingolipid metabolites. In doing so we hope to determine if cells in the peritoneal cavity are a viable target for ovarian cancer treatment rather than, or in addition to the cancer cells itself. This could be useful for the design of a novel prevention strategy..

Mentor(s): Dr. Eva Schmelz

4. Keith K Compton

Sinorhizobium meliloti uses McpX for chemotaxis toward host-exuded betaines

The soil bacterium S. meliloti engages in a symbiosis with its host plant, alfalfa, to provide fixed nitrogen to the plant in exchange for a carbon energy source. Other legumes that rely on this type of symbiosis include broad beans, soy and peas, which are major crop sources of protein. The bacteria may use chemotaxis to seek out their respective hosts. We show that some of the quaternary nitrogen compounds classified as betaines are, along with other exuded molecules, chemoattractants for S. meliloti. Chemotaxis experiments have shown that Methyl-accepting Chemotaxis Protein X plays a role in the perception of betaines, and competitivity assays indicate that chemotaxis is important in the formation of symbiotic nodules in alfalfa..

Mentor(s): Dr. Birgit Scharf

5. Elizabeth A P Denson

Examining the chemotaxis and motility of spontaneous Salmonella Typhimurium VNP20009 mutants

Salmonella Typhimurium VNP20009 is a bacterial strain that was genetically engineered as an antitumor agent. We hypothesize that VNP20009 uses chemotaxis and motility to seek out tumors for preferential colonization over healthy tissue. Chemotaxis is the movement of a cell in response to chemical stimuli. It was previously found that VNP20009 is chemotactically inactive due to a mutation in the chemotaxis response regulator, CheY. Spontaneous mutants of VNP20009, isolated in our lab, regained the ability to exhibit chemotaxis. In an effort to find an explanation for this phenotype, the genomes of the mutants were sequenced. It was discovered that the mutants had single nucleotide polymorphisms in the flagellar switch protein, FliM. To gain better understanding of the interaction between activated CheY and FliM, Lambda Red genetic engineering was used to delete the gene cheY in the VNP20009 spontaneous mutants. These new mutants were then analyzed based on capillary assays, and swim plates for their chemotactic ability. Our work shows that the deletion of cheY presents a loss of the motile and chemotactic phenotype, and that the spontaneous mutants regained the chemotaxis phenotype that VNP20009 lost. Next we will examine VNP20009's sensitivity to individual chemoattractants to optimize tumor seeking. With this knowledge, more insight will be gained into the interaction between tumors within a host and VNP20009.

Mentor(s): Dr. Birgit Scharf

6. Jiale Du

Synthesis of Estrogen Receptor Ligands for Endocrine-Resistant Breast Cancer

Breast cancer is a lethal disease, and there are many bioorganic approaches to prevent breast cancer. Our approach is to synthesize a specific estrogen receptor modulator (SERM) particular for attacking estrogen receptor α (ERα), and thus preventing proliferation in the breast tissue. The estrogen receptor α ligand, termed OBHS (7-oxa-bicyclo[2.2.1]heptene sulfonate) is an effective antagonist. In this study, we utilize the Diels-Alder reaction to synthesize OBHS derivatives; similar to OBHS, these ligands are specific for ERα. The OBHS derivatives also exhibit antiproliferative activity and increasing ligand binding affinity. These derivatives will contain a variety of alkyne and amide side chains, containing heteroatoms with hydrogen bonding capabilities. By introducing these side chains at the dimer interface, we hope to prevent the dimerization of the ligand. This prevention inhibits the transcription of breast cancer genes. To achieve the synthesis of the OBHS derivatives, we first synthesized 4-iodophenyl ethenesulfonate and 4,4'-(furan-3,4-diyl)diphenol, with a yield of 92% and 99%, respectively. Once the Diels-Alder reaction has been completed, Sonogashira and Buckwald Amination coupling will be used to couple the amides and alkynes. The synthesized OBHS derivatives will then be tested on the MCF-7 breast cancer cell line. With the synthesis of these amide and alkyne coupled OBHS derivatives, we hope to inhibit the formation breast cancer cells.

Mentor(s): Dr. Jatinder S. Josan

7. Alana M Dudek

Red-dy for Parenthood? A study on the correlation between female epaulet feathers and incubation behavior

The physiological condition of a female bird may influence her behavior during the breeding season, and as a result, alter her reproductive success. Females in better condition may invest more resources in all aspects of reproduction, including the incubation of eggs. Incubation is important to embryonic development, and females that spend less time incubating more frequently leave their nest vulnerable to predation. Female red-winged blackbirds epaulet colors can indicate a female's condition at her previous molt, and thus, could correlate with incubation behavior. Pigments called carotenoids are responsible for red feathers, and brighter red feathers signal that a female is in good condition. I predicted that the females with brighter red epaulets were in better condition, and thus increased their reproductive effort by spending more time incubating. We evaluated female coloration by 1) measuring feather brightness, via the reflectance of the orange and red chroma and 2) estimating the percent of feathers that are red on the epaulets. We assessed incubation behavior by placing an iButton temperature logger in each female's nest to measure the change in temperature over eight hours. Our results will illustrate whether or not female coloration is a good predictor of reproductive effort.

Mentor(s): Dr. Ignacio Moore

8. Cynthia M. Guerin

Social Cognitive Determinants of Type 2 Diabetes Management among African Americans in Medically Underserved Areas of Virginia: Preliminary Results

Purpose: To discover the variables that aid in managing and reducing the severity of type 2 diabetes for African Americans in medically underserved areas of Virginia. Methods: Three churches in each of seven areas around Virginia agreed to participate in the study. An average of 15 participants enrolled from each church (n=231). Sample was 75% female, had a mean BMI of 34.37, a mean age of 63.01, a mean education of 13.4 years, was 96% African American, 80% diabetic, and 20% prediabetic. A baseline for blood sugar levels (A1c: a 3-month blood sugar measure), behavior (self-regulation), and various social cognitive variables (social support, diabetes and food health knowledge, self-efficacy, and negative outcome expectation) were gathered and were compared to three-month posttest data for those same measures to see what changes had occurred. Demographics (Age, BMI, gender, and education) were also collected. A pretest-posttest correlational design will be used to analyze which variables' changes have the strongest correlation with a change in blood sugar levels. Preliminary Results: Increased self-efficacy and decreased negative outcome expectations were directly correlated with a decrease in A1c. Increased social support and increased self-regulation were mediated by self-efficacy to decrease A1c.

Mentor(s):Dr. Eileen Anderson-Bill

9. David Hampton

The Role of Quorum Sensing In Leaf Litter Decomposition

Microbial communities are vital drivers of ecological processes, such as leaf litter decomposition. Understanding community interaction, and in turn how such interactions influence the environment, is fundamental to our understanding of ecosystems. One key interaction that may shape microbial communities is quorum sensing, a type of density dependent cell-to-cell chemically mediated communication. Here, we examine how manipulation of quorum sensing via the addition of enzymes aimed to up or down regulate sensing, interacts with leaf litter samples and three selected microbial communities. Each leaf litter sample was inoculated with one of three microbe communities, had a weekly addition of compound, and monitored over a thirty day period via Infrared Gas Analysis. We found that the addition of a quorum sense enzyme lead to a 7% increase in rates of leaf litter mineralization compared to both the control and an added quorum quench enzyme. Also, a slight interaction between added compound and source community was also noted. We speculate that this interaction may potentially mediate competitive dynamics within the microbial community and are currently examining this possibility. Our results suggest that quorum sensing does play a role in regulating leaf litter breakdown, but that the community in question may influence this role.

Mentor(s): Dr. Michael Strickland

10. Zachary W Kemp

The Effect of Amyotrophic Lateral Sclerosis Causing Mutations on the Wiring of the Nervous System

Amyotrophic Lateral Sclerosis (ALS) is a neurodegenerative disease known to target alpha motor neurons. These neurons form neuromuscular junctions (NMJs) with skeletal muscles. The disease is thought to begin to degrade the motor system later in life in a G93A-SOD1 mouse model. However, recent studies suggest that the motor system and motor neurons may be affected much earlier in life in this model. For this purpose, I investigated if ALS affected neural development through a comparative analysis of multiple innervation and the subcellular localization of synaptophysin. By postnatal day 9, most NMJs are composed of one nerve ending innervating a muscle fiber, the synaptic vesicles are primarily concentrated at the end of the axon, and the cluster of acetylcholine receptors have begun to mature into a pretzel-like structure. I hypothesized that ALS would attenuate the development of this synapse. Initial data analysis indicates that NMJs mature faster in ALS-affected newborn mice with 10% of ALS synapses experienced multiple innervation, compared to 30% of control synapses ($p=0.003$). These results suggest that ALS causing mutations have a destructive effect on neurons by accelerating development, implying that the nervous system could deteriorate over time as opposed to a direct elderly onset. The disease mechanism revealed by this study could help establish early patient care strategies and methods of developmental pharmaceutical intervention.

Mentor(s): Dr. Gregorio Valdez

11. Mi Song Kim

Disabled-2 modulates cancer cell adhesion by competing integrin and sulfatide-mediated binding

Platelets' role in cancer progression and metastasis has largely been attributed to platelet-mediated enhancement of tumor cell survival, extravasation, and angiogenesis. Correlations exist between the ability of tumor cells to aggregate platelets in vitro and their metastatic potential in vivo which is manifested as a hypercoagulable state found in most cancer patients. We have identified a tumor suppressor molecule (Dab-2) that it is released upon platelet activation and modulates the extent of blood clotting. Dab-2 binds to both αIIbβ3 integrin receptor and sulfatides, thus transiently inhibiting platelet aggregation by blocking P-selectin amplification. This project explores the efficacy of Dab-2 derived peptides in modulating platelet-cancer cell interactions. We reconstitute the platelet cell membrane in vitro and use liposomes to monitor their interactions with cancerous monocytes (U937) that are rich in integrins. Our data show that Dab-2/sulfatide recognition influences the stability of platelet-like structures bound to cancer cells. Results from these studies will lead to creating target metastatic treatments from Dab-2 derived peptides.

Mentor(s): Dr. Carla V. Finkielstein

12. Ki Lee

Insecticidal Effect of Truvia on Mosquitoes

It is well known that mosquitoes are significant vectors of many viral and parasitic agents. Aedes aegypti and Anopheles gambiae are particularly deadly vectors, causing significant morbidity and mortality each year. Another study, using Drosophila melanogaster, recently demonstrated the insecticidal potential of erythritol, the main ingredient in the commercial sweetener Truvia. In the present study we investigated the effect of erythritol on disease vector mosquitoes at different life stages. Our survival curve results showed that the chemical ingredient had an insecticidal effect on both species of adult mosquitoes. Visual observations suggest there is impairment of motor functions in mosquitoes that have ingested erythritol. Overall, our results suggest that erythritol is a mosquito-lethal ingredient and may have some potential as a novel insecticide.

Mentor(s): Dr. Kevin Myles

13. Holly E Packard

Exploring Temporal Control of Quorum Sensing Genes in Pantoea stewartii

Pantoea stewartii subsp. stewartii is a plant pathogen that causes Stewart's wilt in sweet corn plants. Infection occurs in the xylem, where the bacterium utilizes quorum sensing (QS) to create a biofilm with high levels of exopolysaccharide (ESP). EsaR, the master QS regulator controls many genes, including those involved in capsule production, surface motility and adhesion, and stress response. It is thought that the timing of QS gene expression during growth is crucial for infection. The current study was used to determine the temporal control of select QS-regulated genes using transcriptional fusions of the genes with a green fluorescent protein (GFP) reporter. The specific genes studied were rcsA, wceL, lrhA, and CKS0458. The esaI gene, which is the synthase for acyl homoserine-lactone (AHL) signal, was used as a constitutive control. Constructs of each promoter ligated to the GFP reporter gene were made within the unstable p-PROBE'-gfp[LAA] vector and the stable p-PROBE'-gfp[tagless] vector. Gene expression was monitored using fluorescence levels of the GFP plasmids that contain the inserts over the course of growth in liquid culture. Understanding the expression patterns of QS controlled genes during the growth of the culture will give insight into the temporal control with regard to virulence.

Mentor(s): Dr. Ann Stevens

14. Grace A Parker

Does a brief delay in access to feed at hatch influence pancreatic glucose regulatory gene expression in chicks?

A greater understanding of the molecular mechanisms underlying nutrient assimilation and glucose regulation to optimize nutrition may increase growth rate, feed efficiency, and breast muscle in chickens. This study evaluates the effects of a 72-hour delay in access to feed and developmental regulation of mRNA abundance of glucose regulatory genes and islet mass of the pancreas in two lines of chickens. Total RNA was isolated from pancreas samples collected at day of hatch (DOH) and days 1, 3, 7, and 15 and quantified spectrophotometrically. Gel electrophoresis was performed to assess integrity, reverse transcription was performed to synthesize cDNA, and real time PCR was used to measure mRNA abundance for pancreatic and duodenal homeobox 1 (PDX1), pre-proinsulin, pre-proglucagon, and glucose transporter 2 (GLUT2). Stained cross-sections of pancreas were generated to determine the density and mass of islets. The statistical model for mRNA abundance data includes the effect of feed ad libitum or delayed access to feed at day 15, genetic line, and the 2-way interaction, as well as the effect of age. The statistical model for the histology data includes the effect of age, the effect of the HWS or LWS lines, and the 2-way interaction. Significance will be assigned at $P < 0.05$, and Tukey's test will be used for post-hoc pairwise comparisons.

Mentor(s): Dr. Elizabeth R. Gilbert

15. Kaitlyn M Phillips

Investigating Defense Mutualisms: Under what conditions is Chaetogaster limnaei limnaei a mutualist or parasite of snails?

Mutualisms are relationships between two species that benefit both species. Recent work suggests that these relationships may not be fixed and there may be gradients of benefits and costs for the species involved. Defense mutualisms are a special class of mutualism in which a symbiont defends its host from a natural enemy, frequently a parasite. These relationships can have important implications for host health and more broadly can influence disease dynamics in natural systems. To investigate whether the net effect of defensive symbionts on host fitness is changed by the presence and abundance of natural enemies, I investigated the defense mutualism between the annelid Chaetogaster limnaei limnaei and its aquatic snail host. I performed an experiment where defensive symbionts were present or absent and hosts were exposed to parasites at three densities: control, low, and high densities. Snail fitness was measured via growth, survival, and reproductive success. Preliminary results suggest a trend of reduced growth in snails that have Chaetogaster. Other papers have demonstrated that Chaetogaster can reduce snail growth, suggesting that there is a cost for harboring Chaetogaster. This experiment serves to broaden our knowledge about the context-dependent nature of mutualisms.

Mentor(s): Dr. Lisa Belden

16. Morgan E Simpson

Novel class of anti-malarial compounds: in vitro negative selection to reduce potential side effects in humans

Malaria threatens nearly 40% of the world's population, and new compounds are urgently needed due to increasing drug resistance to the current antimalarials. One promising potential target is the methylerythritol phosphate (MEP) pathway, located in the apicoplast. This pathway is used to synthesize isoprenoids which are essential for survival of the malaria parasite and is absent in the human host. However, microorganisms within the human gut possess this pathway, and are necessary to the host. Ideally, any new antimalarials developed will kill the malaria parasite without affecting the microflora of the human gut, thus reducing or eliminating drug-induced side effects. Our laboratory had identified a new potential antimalarial lead that may target the MEP pathway. Several analogs have been synthesized to improve parasiticidal activity and lower off-target toxicity. In order to address potential toxicity to the human gut microflora, Escherichia coli was used as a representative organism. Several potential antimalarial compounds were screened for inhibition of E. coli. Preliminary results show that all three new compounds that were effective against the lethal strain of malaria parasite did not inhibit E. coli growth under aerobic conditions.

Mentor(s): Dr. Maria Belen Cassera

17. Caroline J Stephenson

Novel regulation of Tollip protein following low-dose lipopolysaccharide exposure in innate macrophages

Toll-interacting protein (Tollip) is an adaptor protein that interacts with Toll-like receptor 4 (TLR4). TLR4 pathway is essential for host response to lipopolysaccharide (LPS), a TLR agonist. However, the regulation and role of Tollip is not well understood. This project seeks to elucidate the regulation of Tollip protein level and its subcellular distribution within macrophages following TLR4 activation. To achieve this objective, we employed the techniques of Western blot analyses and confocal microscopy with bone marrow-derived macrophages (BMDM) treated with a 50 pg/mL dose of LPS. BMDM from wild-type C57BL/6 mice were exposed to low-dose challenges of LPS for either 1, 8 or 24 h. Whole protein lysates were harvested and analyzed by Western blot with a Tollip-specific antibody. To determine its subcellular distribution, we stained the BMDM with a Tollip-specific antibody, together with subcellular markers of endosome (LAMP-1) and mitochondria (mito-tracker Red). The expected results should reveal the regulation of Tollip protein level and subcellular distribution in innate macrophages exposed to LPS. The potential findings from this study would assist in defining Tollip's role in low grade inflammation triggered by low-grade endotoxemia, a phenomenon commonly present in humans with chronic diseases. On a larger scale, understanding the various pathways of Tollip would help explain the correlation found between TOLLIP gene polymorphisms and susceptibility to illnesses.

Mentor(s): Dr. Liwu Li

18. Austin A Tatum

Impacts of Aging and Cholinergic Activity on Spinal Cord Motor Neurons

The motor system undergoes significant changes during aging and the progression of diseases. Although we know of many changes that occur at the neuromuscular junction, the final output of the motor system where motor neurons and muscles synapse, much less is known about the changes that occur in motor synapses in the spinal cord and brain. In this study, I examined cholinergic and glutamatergic synapses that form on aging motor neurons in the spinal cord. In parallel, I studied the effect of enhancing and reducing cholinergic activity on such synapses using mice with increased (Hyper) or reduced (KD) levels of the vesicular acetylcholine transporter (VAChT), a protein required to package Acetylcholine into synaptic vesicles. To start, I used two well-established motor performance tests to determine the integrity of the motor system in aged and transgenic animals. I found that VAChT-KD animals performed worse on behavioral tests than control mice. Using confocal microscopy, I then examined whether these differences in behavioral performance correlated with noticeable changes in synapses on motor neurons. Preliminary images suggest that the number, size, and distribution of cholinergic and glutamatergic synapses are altered in aged VAChT-KD and VAChT-Hyper mice compared to control animals. Further analysis should provide greater insights regarding the effect of aging and cholinergic levels on synapses formed on motor neurons.

Mentor(s): Dr. Greg Valdez

19. Hannah K Toutkoushian

The examination of YpeB specific cleavage by HtrC in Bacillus anthracis

Bacillus anthracis is the spore-forming bacterium responsible for the infectious disease anthrax. In its spore form, B. anthracis is highly resistant to common decontamination efforts, while the germinated cell is significantly more susceptible to antibiotics or chemical treatments. During germination, several events take place including cleavage of the germination-related protein YpeB. One of the enzymes responsible for this cleavage is a serine-type protease, HtrC. While in vitro experiments have shown an interaction between these two proteins, in vivo studies demonstrated that YpeB is still cleaved and germination occurs at a normal rate in the absence of HtrC. A proposed explanation for this discrepancy is that HtrC's presence in the cell physically prevents other proteases from interacting with YpeB. To test this hypothesis, two possible active site residues in HtrC were mutated, potentially eliminating the protein's catalytic activity. Through germination rate assays and western blot analysis using these mutated strains, the identity of HtrC's active site and its role in the cleavage of YpeB will be further explored. In determining the method by which YpeB is cleaved, we will gain a better understanding of germination in B. anthracis, which may be applied to research on inducing germination for decontamination purposes.

Mentor(s): Dr. David Popham

20. Leigh A Vogelbein

Life Histories of Ectosymbiont

Most organisms interact with symbiotic partners and these interactions are often key to their survival. Symbiotic organisms also contribute substantially to ecosystem functioning, impacting life cycles, and influencing biodiversity. Interactions between crayfish and ectosymbiotic worms (Annelida: Branchiobdella) provide an efficient model to study symbioses in natural systems. Previous studies have shown that worm populations can have a positive effect on crayfish growth, but an excessive number of worms on a single host can shift the relationship from mutualistic to parasitic, resulting in reduced host growth. The worms partition the host body spatially, possibly in an effort to reduce competition with other worms for resources. However, little is known about the specific life histories of individual species, information necessary to evaluate potential competition. To quantify branchiobdellidan life history characteristics, individual species of worms were placed on isolated crayfish in submerged, flow-through cages in a local stream to simulate a natural environment. We evaluated their realized niche, fecundity and overall life cycle characteristics. We hypothesized that variation in life history traits such as generation time and reproductive rate would explain coexistence in these symbionts. Of particular interest were whether certain species displayed hallmarks of early colonization techniques: faster reproduction and shorter lifespans.

Mentor(s): Dr. Bryan Brown

21. Thomas A E Wood

Reproductive isolation in two populations of Anolis sagrei differing in levels of sexual size dimorphism

Sexual selection may facilitate the evolution of new species by accelerating divergence in mating preferences and/or the development of genetic incompatibilities between populations. Here, we test for the presence of reproductive isolation between two island populations of the lizard Anolis sagrei that differ in sexual size dimorphism, a proxy for the strength of sexual selection. We performed both within- and between-population crosses of adults from the Bahamian islands of Exuma and Eleuthera, which show high and low levels of sexual dimorphism, respectively. Between-population crosses produced significantly fewer eggs than within-population crosses, though we found no significant difference in hatching success or hatchling viability. Using measurements of mass and length, we show that there is no significant difference in the growth of the hybrids over three months when compared to lizards born within either population. We see a significant maternal effect on hatch weight, with juveniles born to females from Eleuthera being slightly larger at hatching. There is also a significant paternal effect on length and mass after hatching, with fathers from Eleuthera producing slightly larger offspring. These results suggest that the reproductive isolation seen may be prezygotic, occurring either via reduced mating rate or gametic incompatibilities.

Mentor(s): Dr. Joel McGlothlin

22. Diana O Woodrum, Joey Droter

Recoverability of Salmonella spp. on cumin and peppercorn seeds in different media

Currently, there is research being done in the Food Science and Technology department at Virginia Tech to develop methods to inactivate Salmonella on spices due to the fact that spices have been associated with outbreaks. The purpose of this project is to determine if pre-enriching inoculated spices would show increased recoverability of Salmonella to aide in further research. Three different pre-enrichment broths (peptone 0.1%, buffered peptone water with ferrioxamine E, and TSB) were tested on three different treatments: inoculated spices and inoculated spices that underwent an ethanol vapor treatment for either three minutes or five minutes. The procedure was done for both peppercorn and cumin. The results showed that the ethanol vapor treatment effectively reduced the number of CFU/g Salmonella, but it was unclear as to which pre-enrichment broth improved the recoverability the most post-treatment. It's evident that pre-enrichment broths aid in the recovery of Salmonella, and even though this experiment didn't show a large difference between the three broths, other enrichment broths can be tested in the future.

Mentor(s): Dr. Monica Ponder

23. Courtney E Youngbar

The Influence of Handedness on Disease Transmission in House Finches

An animal's handedness, or limb-use preference, can be influential in the transmission of disease. Here, we evaluated the possible handedness of house finches and whether that preference predicted which eye became more severely infected with conjunctivitis caused by the bacterium Mycoplasma gallisepticum. Because this common bacteria pathogen of house finches is largely spread through contact with bird feeders, we focused on individual handedness during foraging. One hour videos of ten captive flocks of house finches were taken for three of the five days before an experimental epidemic was initiated within each flock. These videos were evaluated for handedness by noting which side of the feeder a bird ate from while foraging. In order to test whether handedness influenced disease transmission, we initiated experimental epidemics in each flock by inoculating a single bird per flock (index bird) with Mycoplasma gallisepticum in both eyes. All birds in each flock were evaluated for transmission every other day for three weeks post-inoculation by recording separate pathology scores of each eye and by swabbing each eye for later detection of M. gallisepticum via qPCR. Excluding the index birds, we expect that the side, left or right, that each bird favors during their foraging bouts will be the side more likely to show signs of Mycoplasmal conjunctivitis. We will discuss our results and the contributions of our findings to the study of disease transmission in house finches.

Mentor(s): Dr. Dana Hawley

24. Shelton Boyd

Functional characterization of variants of the Arabidopsis amino acid transporter AAP1s

Engineering amino acid transport and its regulation in plants has been proposed as a method of enhancing crop nutrition and nitrogen allocation. While the first plant amino acid transporters were isolated about 20 years ago, the role of only a dozen of them is known, and the regulatory pathways of their activity are not identified. A forward genetic screening aiming to isolate Arabidopsis mutants affected in amino acid regulatory pathways led to the identification of 18 such mutants, able to grow in toxic concentrations of amino acids. Seven of these mutations were determined by genetic mapping to affect the previously characterized amino transporter AAP1. The mutations in the AAP1 locus for each of the seven mutants was confirmed by PCR and sequencing. The variant AAP1 cDNAs were cloned using Gateway technology in a yeast expression vector. A yeast strain deficient in endogenous amino acid transport was used for complementation assays, in order to test for the function of the AAP1 variants. Preliminary data suggests that, contrary to wild type AAP1, the AAP1 variants cannot restore yeast growth on selective media, and are thus not functional for amino acid transport in yeast. More complete findings will be presented at the Symposium.

Mentor(s): Dr. Guillaume Pilot

25. Valentina Alaasam

Morphology and Physiology of brooding and non-brooding male eastern hellbenders (Cryptobranchus alleganiensis)

The eastern hellbender (Cryptobranchus alleganiensis) is a unique and understudied N. American species of salamander that is of conservation concern throughout its range. Population declines have been characterized by a lack of recruitment, yet little is known about hellbender reproductive behavior except that adult males provide parental care of eggs through hatching and early development. One possible explanation for declines is that fewer males are guarding nests through hatching, and so this study was designed to determine morphological and physiological factors associated with alternative male reproductive states described as brooding (guarding a nest of eggs) and non-brooding (not guarding any offspring). We sampled 25 males pre-breeding season between July 6th – July 17th, within two 100-meter stream reaches where hellbenders are known to occur. We measured size, body condition, and head width, as well as blood plasma levels of prolactin, testosterone via radio immunoassay, and corticosterone via enzyme immunoassay. We collected blood <3min and >60min post-capture to measure baseline and stress-induced hormone levels respectively. We also used PIT tags to mark individuals and will re-capture males when nests are being established to identify their reproductive state. Understanding brooding and non-brooding male physiology will aid in conservation efforts to increase species recruitment and contribute to our limited knowledge of hellbender nesting ecology.

Mentor(s): Dr. William Hopkins

26.Kevin M Potts

Substrate preference of an Appalachian stream snail and its effect on infection rates of digenetic trematodes

Host habitat preference affects parasite transmission in natural systems. Digenetic trematodes are parasitic flatworms with complex, multi-host life cycles. They infect all classes of vertebrates, but always require a molluscan first-intermediate host, and are found in aquatic snails. Here, I investigated the microhabitat preference of the stream snail Elimia proxima, which is the first-intermediate host to several species of trematodes. The purpose of this study was to determine if larger populations of snails and snails with trematode infections can be predictably found on certain substrates compared to others. Substrate preference and prevalence of infection was investigated observationally and experimentally. First, I used repeat quadrat sampling to measure snail density on different substrates (Sand/silt, gravel/cobble, boulder/bedrock, wood/leaves) then dissected those snails for the presence of parasites. Second, I placed traps containing different substrate types in the stream to determine rates of snail colonization. This study will hopefully help researchers studying macroinvertebrate populations or infection rates in streams by alerting them that samples that do not include all available substrate types and stream features will cause deviations in their results. My results will help us better understand the dynamics of stream parasites by determining the role microhabitats play in stream parasite ecology.

Mentor(s): Dr. Lisa Belden

27. Celeste Blum, Will Heydinger

α-Glucan Phosphorylase from a Hyperthermophilic Bacterium Thermotoga Maritima and its Mutants: Kinetics Characterization and Stability Study

α-glucan phosphorylases (αGPs) or starch phosphorylases are enzymes that catalyze phosphorolytic shortening of starch by one glucosyl unit from a non-reducing end yielding D- glucose 1-phosphate (G-1-P) and extending of starch one glucosyl unit to a non-reducing end from G-1-P. Thermostable αGPs could be used for the production of hydrogen, transformation of cellulose into synthetic starch, and many other value-added products. In this study, plasmids containing αGP, from the bacteria Thermotoga maritima and its mutants, were expressed in Escherichia coli BL21 (DE3). Wild-type αGP (TmαGP) was purified as well as two mutant TmαGPs. One mutant with the mutation at site 227 from cysteine (C) to alanine (A) was called Mutant A; the other mutant with the mutations at sites 227 and 103 both from cysteine (C) to alanine (A) was called Mutant B. Polyacrylamide gel electrophoresis (SDS-PAGE) confirmed the expected MWs of TmaGP and its mutants at about 95 kDa. The enzyme activities were assayed at 70 oC in 50 mM HEPES buffer (pH 7.20) containing 10mM dextrin DP19 and 10 mM G-1-P or 10 mM inorganic phosphate. For the synthesis direction, the product, inorganic phosphate released from G-1-P, was measured by a mild pH phosphate assay. Initial reaction rates with respect to maltodextin concentration are to be measured in order to determine the Michaelis-Menten constant Km and kcat. For the degradation direction, the product G-1-P was measured using a glucose hexokinase/glucose-6-phosphate dehydrogenase assay kit supplemented with a recombinant phosphoglucomutase. The thermostability of each enzyme was determined by the percent activity that remained after heat-treating at 95oC for one hour. TmαGP, Mutant A, and Mutant B withheld 11, 23, and 15% of their activities without heat treatment, respectively. Dithiothreitol (DTT) decreased the thermostability of all TmaGPs.

Mentor(s): Dr. Chun You

28. Vincent A Encinas

Structure/property Analysis of the Honey Locust (Gleditsia triacanthos) Thorn

The Honey Locust (Gledistisia triacanthos a.k.a thorny locust) is a native Virginia deciduous hardwood tree known for its many long and pointy thorns. The thorns grow on both the branches and trunk of the tree and can reach as long as sixteen inches in length. The tree is commonly used by the timber industry because the wood is known to be very dense and shock resistant. The fundamental structure/property relationships for this unusual lignocellulosic tissue have not been explored, and this is the principal objective for this study. Specifically this work compares the chemistry and cellular anatomies of the stem and thorn. Anatomical comparisons were conducted using light microscopy and scanning electron microscopy. Chemical comparisons be based upon the standard compositional analysis published by the National Renewable Energy Laboratory (NREL) procedure of TP-510-42618 (Determination of Structural Carbohydrates and Lignin in Biomass). Although the chemical analysis has yet to produce results, it is in the process of being completed. Results using microscopy have shown interesting similarities and differences between the Honey Locust thorn and stem.

Mentor(s): Dr. Chip Frazier

29. Simone C Gelinas

New production routes to large amyloid fibers

Amyloids are self-assembling proteins that exist in nature as functional materials such as insect silk and barnacle cement. These naturally produced amyloids are assembled through a mechanism supported by their respective hosts. However, such fibers can be synthesized in a laboratory setting without the need for substantial energy by creating specific combinations of proteins. Amyloids have a core beta-sheet structure and through more densely packed beta-sheets, the fibers will acquire a higher modulus, which is desired for functional use. Different types of protein mixtures are analyzed with Fourier transform infrared (FT-IR) spectroscopy as a function of incubation time. The shift in the Amide I absorbance reflects the transformation of alpha helices to high-density beta sheets. After 480 hours of incubation, the solutions are dried and any resulting fibers characterized. Alpha-chymotrypsin hydrolyzed wheat gluten produces amyloid fibers but through a different route than trypsin hydrolyzed wheat gluten, showing that the same protein deconstructed into 2 separate types of protein mixtures can have a different result. Trypsin hydrolyzed ovalbumin also produces fibers but is a more robust fiber former when mixed with trypsin hydrolyzed gliadin.

Mentor(s): Dr. Justin Barone

30. Nathan D Harms

Preservation of Lipid-PLGA Hybrid Nanoparticles via Lyophilisation

Protein encased in Poly(lactic-co¬-glycolic acid) and lipisol create hybrid nanoparticles (NP) that have been shown to be an effective drug delivery system for a variety of different diseases. Yet, these hybrid NP have one flaw: they must be made and used readily to avoid BSA leakage and degradation of the PLGA/lipisol shell. In this project, lyophilisation (freeze-drying) was researched as a counter to this problem. Freeze-drying is frequently implemented in the biopharmaceutical industry as a method of preservation; however, lyoprotectants (drying protectants) and cryoprotectants (freezing protectants) need to be added to the biopharmaceutical to maintain integrity of the compound. For these hybrid NP, eleven different protectants were extensively tested and it was determined that mannitol is the best protectant because it showed no size change in NP size before and after freeze-drying. Further experimentation will reveal which concentration of NP and which mass ratio of mannitol to NP will be most successful for larger processes.

Mentor(s): Dr. Mike Zhang

31. Benjamin P Heithoff

Inducible signal propagation of a synthetic gene circuit in an emulsion droplet

Synthetic biologists are rapidly generating tools to enhance human health by precisely programming cell phenotype. By transforming cells with synthetic gene circuits, new lines can be formed and functionalized. Ideally, spatial segregation of different colonies would allow for increased complexity and higher order processing by a single synthetic gene circuit. We have designed and created a system using droplet-based microfluidics to spatially segregate individual colonies of synthetically programmed cells. We used photolithographic fabrication processes to generate a microfluidic encapsulating system. Using standard molecular cloning approaches, we engineered E. coli with a toggle switch to allow for memory and signal propagation. We encapsulated cells in hydrophilic media surrounded by lipophilic oil. Cells that contained a specialized genetic toggle circuit could be switched to a different memory state by an amphiphilic, quorum-sensing molecule [acyl-homoserine lactone (AHL). Cells can be programmed to generate the molecule or AHL can be provided; thus, a community of cells can change its memory state sequentially, allowing for spatial propagation of the AHL signal through mulitple adjacent colonies. Ultimately, these circuits can control delivery of recombinant peptides (i.e. peptide expression triggered by a propagating signal), and thus could impact fields ranging from biophysics and systems biology to drug delivery and engineered peptide-based cancer therapeutics.

Mentor(s): Dr. Warren Ruder

32. Victoria Morales

Engineering the cellulose-consuming Clostridium cellulolyticum H10 by media optimization and gene knock-outs

The anaerobic bacterium Clostridium cellulolyticum H10 is of interest for its ability to degrade plant cellulose and convert it into high-value chemicals and biofuels. The wild-type C. cellulolyticum produces large exopolysaccharides byproducts and grows very slowly. Our goal, in working with C. cellulolyticum is to produce a fast-growing strain capable to consuming cellulose quickly. We hypothesized that by eliminating the production of exopolysaccharides, the strain growth rate will increase. To test this hypothesis, we have designed gene knock-outs that target the genes encoding the glycogen/starch synthase and the 1,4-alpha-glycan branching protein. These genes are largely responsible for the production of exopolysaccharides. In addition to gene knock-out, we have also optimized culture media in an attempt to stop their formation and stimulate ethanol production. The culture media optimization was designed using a previously prepared "genome-scale" model of C. cellulolyticum metabolism and a optimization algorithm called the Total Membrane Influx Flux Balance Analysis (ToMI-FBA). Several different media formulations were designed and tested in the laboratory.

Mentor(s): Dr. Ryan S. Senger

33. Jasmine Naik

Virus-like particles as a vaccine against porcine reproductive and respiratory syndrome virus (PRRSV)

Porcine Reproductive and Respiratory Syndrome (PRRS) is a devastating disease causing up to $600 million per year in loss to the pork industry in the United States alone. Several vaccines currently exist including killed live vaccines (KLV) and modified live vaccines (MLV). These vaccines have known issues including safety and efficacy across multiple strains. Virus-like particle (VLP) based vaccines are becoming a viable alternative to subunit vaccines, as they contain the antigens in more veritable conformation and are readily recognized by the immune system. Hepatitis B virus (HBV) core antigen (HBcAg) is very well studied and has been successfully used as a carrier for more than 100 other viral sequences. In this study, chimeric HBcAg proteins are generated by the fusion of three conserved epitopes from PRRS which are expressed in Escherichia coli. A purification protocol including column chromatography is developed to obtain hybrid HBcAg VLP protein from the soluble proteins and inclusion bodies. This hybrid HBcAg VLP protein is then run through SDS page gels and western blots to determine the proteins location. Further tests and development are required for this hybrid VLP to become an important vaccine against PRRS infection.

Mentor(s): Dr. Chenming Zhang

34. Jennifer E Paul

Expressing Red Fluorescent Protein via Synthetic Constructs in Mammalian Cells

Genetic engineering is a complicated process in which certain components of separate genes are amplified and spliced together to create an entirely new plasmid for a specified purpose. Plasmid pDW011 was constructed and engineered to express RFP (MCherry) in mammalian cells by activating it with blue light. At rest, the cells did not express RFP because the VP16 protein within the cell was coiled. Upon irradiation with light, the VP16 protein uncoiled and the dFKF1 gene bound to the end of VP16 was able to bind with the GI-Gal gene, prompting production of MCherry within the cell. The ability to express RFP in mammalian cells is the first step towards inserting specific genes into mammalian cells and ultimately manipulating their cell cycle using light. Since it was possible to trigger the plasmid to express RFP using light irradiation, it follows that a variety of different genes could be put in place of MCherry and bound to the base plasmid.

Mentor(s): Dr. Warren Ruder

35. David E Roth

Genetically engineering large amyloid fibers

Amyloids are insoluble fibrous protein aggregations that have been studied in the past by medical researchers for their role in Alzheimer's, Parkinson's and Huntington's diseases, among other pathogenic processes. However, the fibrous structures formed in amyloid aggregation exhibit desirable traits as engineering materials and have the potential to act as replacements for petroleum based polymers. It has been shown that large amyloid fibers of predictable morphological and cross-sectional characteristics can form from a variety of protein mixtures. Building on research performed on amyloid fiber formation in vitro, we have designed experiments to use in vivo cellular expression of proteins to further understand the biochemical forces responsible for amyloid fiber formation. Pinpointing the amino acid sequences responsible for fiber aggregation is an important step in designing engineered fibrous biopolymer structures. Fiber formation is analyzed using atomic force microscopy (AFM) to better understand the mechanism of assembly.

Mentor(s): Dr. Justin Barone

36. Shannen M Scott

Copolymerization of Urushiol in Phenol-Formaldehyde Resole

Phenol-formaldehyde resol (PF) is the dominant thermosetting resin used to manufacture structural wood-based composites. Urushiol (an isomeric mixture of 3-pentadecyl catechols) is best known as the oil responsible for contact dermatitis in poison ivy (Toxicodendron radicans). Urushiol is also present in the sap of the Asian lacquer tree (Toxicodendron vernicifluum), where it serves as a crosslinking agent in the tree's wound response. The crosslinking ability of urushiol is related to its catechol structure, a recurrent theme in natural crosslinking systems as in the mussel marine adhesive, the schlerotization of insect cuticle, and the wound response of the dandelion. The ubiquity of catechol chemistry in these natural crosslinking systems inspires fundamental interest in the copolymerization of urushiol into PF resins. Relative to PF resins, PF/urushiol copolymers are expected to exhibit reduced surface tension, altered cure properties, and perhaps higher toughness. Using the split-cook PF synthesis, PF/urushiol copolymers were synthesized at a 10 mole percent phenol substitution. The resulting changes in liquid resin surface tension, rheology, and cure properties are reported.

Mentor(s): Dr. Chip Frazier

37. Jessica L Symons

Determining mechanisms of toxicity using Raman spectroscopy

Raman spectroscopy is non-destructive to living cells and has been developed to provide quantitative and near real-time measurements of the biochemical composition of microbes. This technique was used in this research to study the physiological changes of bacteria upon toxin exposure. E. coli cells were introduced to numerous toxins at their minimum inhibitory concentrations (MIC) for 30 minutes and then were analyzed by Raman spectroscopy. The Raman spectra were analyzed for specific biochemical signatures, as well as multivariate statistical differences among the spectra. The results of these measurements demonstrated biochemical differences among cells in the presence of different types of toxins, indicating different physiological responses and mechanisms of toxicity. This technique is being used to build a model of toxicity that can be used to probe the toxicity level and mechanism(s) of any uncharacterized environmental contaminant.

Mentor(s): Dr. Ryan Senger

38. Akshay M Iyer, Logan Woodcock

RF Class-F Power Amplifier Design for High Frequency Systems

In radio frequency wireless communications systems, it is necessary to amplify an input (Tx) signal prior to antenna. In this project, a high efficiency harmonic tuned (class F), RF power amplifier is designed that is capable of working reliably in frequency bands between 10 and 18 GHz for this purpose. To work with such high frequencies, CMOS and power transistor technology are essential components in the overall design of this project. Advanced Design System (ADS) software is used to conduct operational and EM simulations and develop the circuit schematics, including the impedance matching networks (pi, L, and T networks) for maximum power transfer from source to load. Also using ADS, DC blocks and feeds are incorporated to maintain the AC input signal. Power Efficiency (PE), Power Added Efficiency (PAE), and small signal S-Parameters are measured.

Mentor(s): Dr. Kwang-Jin Koh

39. Ethel Baber, Danielle Ho, George Vormittag

Outdoor Transmitter Localization

Outdoor transmitter localization is the process of finding a radio signal in an outdoor environment without knowing the exact position of the transmitter. Transmitter localization in an outdoor environment can be useful in responding to emergencies, finding an individual when a GPS implemented device is not available, or detecting the position of malicious attacks on a system. Radio signals can be reflected off many obstructions in an outdoor setting, thus causing multipath distortion, making it harder to locate the transmitter. Due to the vast nature of our project topic, our research focused on a smaller aspect of the larger issue. Specifically, we investigated signal shape and signal strength and their correlation to position with a goal of determining location more accurately. A rogue walkie talkie was used to transmit a signal to a cognitive radio test bed, O-CORNET on the Virginia Tech campus. We expect our findings will indicate that the extension of the signal length and the amount of signal shape distortion will correlate to the amount or type of obstructions between the transmitter and the receiver. More research will be done to determine the exact relationship of these correlations.

Mentor(s): Dr. Louis Beex

40. Elizabeth K Cole, Ian Ho, Edward Powell

Examination and Analysis of Dynamic Spectrum Access

Only a certain range of radio frequencies are allocated for wireless communications, making the radio spectrum a limited natural resource for the staggering growth in wireless devices. To help regulate the use of the radio spectrum in the United States, the Federal Communications Commission allocates and licenses different parts of the spectrum to certain users; however, only about 15-20% of this licensed spectrum is being utilized at any given time. Software Defined Radio and Cognitive Radio, two related emerging technologies, address the underutilization of the radio spectrum through Dynamic Spectrum Access (DSA). DSA is a technique used by multiple users to detect when a channel is free and opportunistically access the channel. Our project models DSA through simulation of a situation in which a primary user transmits data on a channel in random bursts. A secondary user then transmits in bursts on the same channel, but when the primary user is not transmitting data, thus maximizing the use of the channel. The success of this DSA method was measured by the minimization of the primary user's bit error rate. GNU Radio and Universal Software Radio Peripheral platforms were fundamental tools for modeling DSA.

Mentor(s): Dr. Louis Beex

41. Boubacar Abdou Tchoussou, Frank Lykes Claytor

Investigation of the Dynamic Spectrum Access (DSA) approaches in Broadcasting

Cognitive Radio (CR), a novel radio technology intelligent enough to autonomously change its parameters configuration to adapt to its environment, increases the efficient usage of the underutilized radio spectrum. One proposed technique to achieve this goal is Dynamic Spectrum Access (DSA), a technique in which a secondary (unlicensed) user (SU) senses and accesses the idle frequencies of the spectrum band owned by a primary (licensed) user (PU). The term "idle frequencies" refers to parts of the spectrum that are unoccupied at a certain time and location by the primary user. The main focus of our project is to evaluate the performance of the CRs when performing DSA in broadcasting –transmission to multiple receiving radios. Specifically, a C++ program uses open source Liquid-DSP and Cognitive Radio Test System (CRTS) software to test the performance of a CR in different noise scenarios. DSA metrics such as rendezvous time, evacuation time, false alarm, probabilities of detection/misdetection as well as performance metrics such as bit error rate (BER) and packet error rate (PER) are evaluated.

Mentor(s): Dr. Carl Dietrich

42. Katya A Davydova

Peering through the popularity perspective: The effects of self-perceptions of likeability and popularity on recognition of prosocial behavior

Past research indicates that adolescent peers' social status in the school system has a notable impact on interactions and behaviors. The researcher investigated whether differences in self-perceptions of being likeable and being popular affected the number of prosocial events recognized over 7 days on a university campus, and hypothesized that college students rating themselves as more likeable would have a higher propensity to pass on a wristband as recognition for a kind act s/he saw a friend or stranger perform towards another person. Participants completed pre- and post-surveys assessing moderating characteristics of the recognizer, such as sense of community and belongingness, as well as the relationship to the receiver, in addition to ratings of the likeability and popularity constructs on a Likert scale. Likeability is hypothesized to predict an increased frequency of prosocial behaviors recognized, with a stronger relationship for students reporting high belongingness scores. Additionally, self-perceived popular undergraduates are expected to recognize fewer students. Implications further support the importance of examining self-perceptions and popularity on prosocial behavior as well as distinguishing between "being popular" and "being well-liked" on a college campus.

Mentor(s): Dr. Scott Geller

43. Georgiana I Lee

Recognizing the Prosocial Behaviors of College Students: Does Academic Level, Age, or Gender Facilitate Prosocial Recognition?

Various traits and states, prosocial tendencies, motives, and empathic concern have been shown to predict an individual's propensity to perform prosocial behavior. However, only a few studies have explored the factors facilitating prosocial recognition. Prior research has not explored the impact of academic level, age, and gender. Participants from a large university in southwest Virginia were recruited through flyers on campus. They each took a pre-challenge survey and then the participants were asked to participate in seven-day Actively Caring for People Challenge, which encouraged recognizing other people for helping someone else with a wristband. Following the Challenge, a post-survey was given to assess barriers associated with the recognition of prosocial behavior. Participants in higher academic levels are expected to have a higher intention and actual frequency of recognizing prosocial behavior. The relationship between the recognizer and receiver of the wristband (as a friend or stranger) should influence the likelihood. Overall, this study should improve the knowledge base of prosocial recognition, including the associated factors of academic levels, age, and gender.

Mentor(s): Dr. Scott Geller

44. Alvin F Taylor

EXPLORING THE DIMENSIONS OF SANITIZED VIOLENCE AND THEIR EFFECTS: GRAPHICNESS, CONSEQUENCES, JUSTIFICATION, AND PLEASANTNESS

While there has been extensive research dealing with effects of media violence, which is typically portrayed in a "sanitized" manner, there has been less research on how more responsible "unsanitized" portrayals influence viewer responses. As part of a series of studies dealing with effects of sanitized vs. unsanitized portrayals of media violence on responses ranging from prosocial behavior to enjoyment to subsequent media selection, an experiment tested a new conceptualization of the sanitized media violence construct based on four proposed dimensions: graphicness of portrayal, portrayal of consequences, portrayal of justification, and pleasantness of portrayal. A three-condition online experiment tested effects of sanitized and unsanitized portrayals on these conceptual dimensions by exposing participants to a sanitized media violence portrayal (a bar fight against a "villain" character), an unsanitized portrayal (a domestic violence incident), or a control condition with no violence (a party scene) from the New Zealand film Once Were Warriors and compared participants' ratings across conditions for the four proposed media violence sanitization dimensions. Results of a confirmatory factor analysis assessing the dimensionality of the sanitized violence construct, as well as analysis of variance tests comparing responses to each clip, will be presented and implications will be discussed.

Mentor(s): Dr. James D Ivory

45. Bradi M Heaberlin

The Role of Group Status and Competitive/Cooperative Gaming on Observed Helping Behavior in Video Game Players

Past research indicates that playing video games in competitive or cooperative settings may elicit different aggression-related responses in players, with cooperative game play increasing cooperation and reducing aggressive affect and aggressive behavior. Further, past research has found that effects of competitive and cooperative play differ when the co-player is an "in-group" or "out-group" member. That previous research has focused on questionnaire-based measures of aggression; this study expands the prior research in the area by examining the role of in-group and out-group co-player status and competitive and cooperative game play on actual recorded helping behavior and dialogue during game play sessions. Eighty participants, 33 females and 47 males, played a violent video game with an in-group or out-group confederate player. Group status was established via the confederate's t-shirt denoting loyalty to either the current university or a rival university. The confederate prompted the participant for help twice during play. Participants' helping behavior in response to these prompts, as well as other dialogue, was recorded and coded. Results are presented for effects of both play setting (cooperative or competitive) and co-player group status (in-group or out-group) on helping behavior and other dialogue, and implications for research on video game effects are discussed.

Mentor(s): Dr. James D. Ivory

46. Elizabeth N Hanley

Maternal Neuroticism as a Moderator of the Effect of Parenting on Children's Behavioral Inhibition

Behaviorally inhibited children tend to withdraw from novel situations and to show high levels of fear. These children are at risk for developing a range of problems including depression and social anxiety disorders later in life. Thus, it is important to explore early variables that may exacerbate negative outcomes among behaviorally inhibited children. This study addressed the effect of mothers' sensitive, involved, and directive parenting behaviors on children's behavioral inhibition and explored a possible moderating effect of maternal neuroticism. Data were collected from 140 mother-child dyads when children were 30-36 months old. Self-reports of maternal neuroticism were collected, and mothers' parenting behaviors were observed during two free-play activities. Children's behavioral inhibition was observed during a novel situation, where children were shown a jumping spider toy and were encouraged to play with the spider. Behavioral inhibition was measured by the fear children exhibited and by their latency to touch the spider. Increased maternal involvement was moderately associated with children's increased fear. Maternal neuroticism was positively correlated with child behavioral inhibition. Maternal neuroticism moderated the relation between maternal directiveness and children's behavioral inhibition such that the relation of maternal directiveness to children's behavioral inhibition was stronger for mothers high in neuroticism.

Mentor(s): Dr. Cynthia Smith

47. Autumn H Nicely

Are These Gender Differences in How Mothers Interact with Preschool-Aged Children?

Societal gender stereotypes often relate to how boys and girls express emotion where girls are encouraged to express emotion and boys are discouraged from openly expressing emotion. These patterns have the potential for long-term implications; thus, understanding how these develop early in life is important. This study investigated whether child gender was related to the number of child bids and off- topic conversations. Participants were of 116 preschool aged children and their mothers. Participants were predominately middle- class, Caucasian families. Children completed a locked box frustration task, where they were given a set of keys that did not contain the correct key to unlock a box containing attractive toys. Children were given four minutes to attempt to unlock the box. Mothers were in the room during the activity and were instructed to tell their children that they would help them when they were finished with their paperwork. The situation was potentially frustrating because children could not receive help from their mothers and did not have the correct key available. The expected results were that there would be more events between mother-daughter dyads compared to mother-son dyads. The findings have the potential to inform our understanding of how gender stereotypes develop.

Mentor(s): Dr. Cynthia Smith

48. Hadley C Brochu

Do parents' beliefs about children's emotions moderate the relation between children's emotion recognition and their internalizing problems?

The purpose of this study was to determine the extent to which parents' beliefs about children's emotions moderate the relation between children's emotion recognition and their internalizing problems. Participants were 89 mother-child dyads from a larger clinical trial with families seeking treatment for children's oppositional behavior. Children's emotion recognition was measured via the Diagnostic Analysis of Nonverbal Accuracy 2 (DANVA2; Nowicki & Duke, 1994). Children self-reported internalizing problems, and mothers self-reported beliefs about emotions. Three belief subscales were included in this study: parents' guidance is important, emotions are controllable, and children have a right to emotional privacy. Hypotheses are: (1) children with worse emotion recognition skills will be higher in internalizing problems, and (2) this association will be weaker for children with parents higher on the parental guidance subscale and higher in the belief that children have a right to emotional privacy, and stronger for children with parents higher in the belief that emotions are controllable. Findings are important because if parents' beliefs about children's emotions do have a moderating effect on the association between children's emotion recognition and their internalizing problems, then emotion coaching may be a potential target of intervention for children with low emotion recognition skills.

Mentor(s): Dr. Julie Dunsmore

49. Miriam G Clayton

Does Child Age Moderate the Association of Change in Parenting Quality and Children's Symptoms Over the Course of Treatment for ODD?

In this research I consider whether children's age at treatment alters associations between change in parenting quality and change in children's symptoms over the course of treatment for children with Oppositional Defiant Disorder (ODD). Participants were 42 mother-child dyads seeking treatment for children's oppositional behavior. Each dyad was randomly assigned to one of two 10-week clinical treatments. Both treatments were effective in reducing children's symptoms in the larger clinical trial from which this dataset is drawn (Ollendick et al., 2014). Past research suggests that child age may alter the effect of ODD treatment and other parent-child interactions. Pre- and post-treatment parenting quality were measured in terms of parental warmth (observed from videotaped interactions) and parental monitoring and discipline (self-reported). Pre- and post-treatment symptoms were measured by maternal report. I expect that an improvement in parenting quality over the course of treatment will be related to significant decreases in children's ODD symptoms, and that the association of improved parenting quality with reduction of ODD symptoms will be more pronounced in younger than older children. If hypotheses are supported, expected results will reinforce the importance of early intervention and targeted, age-appropriate treatments for ODD.

Mentor(s): Dr. Julie Dunsmore

50. Maria G Haas

Does parental gender moderate the effect of marital satisfaction on parenting?

The "spillover effect" refers to the phenomenon of parent-child relationships being affected by parents' marital relationship quality (Erel & Burman, 1995). This study examined the spillover effect in regard to whether parenting behaviors differed in mother-child dyads compared with father-child dyads. Participants were forty-five parents of 3- to 4 year-old children. Parents reported marital satisfaction on the Marital Adjustment Test (Locke &Wallace, 1959). Parenting was assessed by parents' report on the Ideas about Parenting questionnaire (Heming, Cowan & Cowan, 1991) and the Parents' Beliefs about Emotions questionnaire (Dunsmore & Karn, 2001). I expect that father-child parenting will be more strongly affected by marital satisfaction than mother-child parenting, based on theories that fathering is dictated less by social norms, and therefore is more fragile to outside forces (Belsky, Youngblade, Rovine, & Volling 1991). Previous research suggests that parental gender can moderate the association of marital satisfaction with the parent child relationship, depending on analysis methods. By addressing parenting style and parental emotion socialization behaviors, this study will add to the literature by examining whether the "spillover effect" extends to parenting behaviors as well as parent-child relationship quality.

Mentor(s): Dr. Julie Dunsmore

51. Amanda H Freiborg

Does glycosylation shield bacterial flagellin from plant receptor recoginition?

The flagellin fliC gene is known to cause an immune response in plants due to flg22 and flgII-28 epitopes. These epitopes are generally conserved sequences in fliC. Slight changes cause differing immune response in plants (Clarke et al., 2013). In previous literature, certain serines in a different region of fliC were found to be glycosylated: 143, 164, 176, 183, 193, and 201 (Taguchi et al., 2006). Of the seven fliC alleles in this project, three of them have an alanine at position 183 instead of serine. The hypothesis tested is that different alleles of the region containing the glycosylated serines will affect the strength of the plant immune response triggered by flg22 and flgII by shielding flg22 and flgII from their cognate plant immune receptors. This project consists in constructing chimeric fliC genes whereby different alleles of flg22 and flgII are combined with different variants of the glycosylated region.

Mentor(s): Dr. Boris Vinatzer

52. Leslie A Sepaniac

The promoter activity of Clostridium perfringens cyanophycinase gene cphB

Clostridium perfringens is a Gram-positive, anaerobic, spore forming bacterium causing a wide range of human and animal diseases, such as food poisoning and gas gangrene. Previous studies in the Melville lab found that levels of cyanophycinase, an enzyme that degrades an amino acid nitrogen storage polymer (cyanophycin), were greater in germinating spore membranes than in dormant spore membranes. We hypothesize that C. perfringens spores may synthesize cyanophycin during sporulation using the enzyme cyanophycin synthetase (CphA), and later degrade it using cyanophycinase (CphB), enabling the spores to utilize cyanophycinase as a nutrient resource during germination. To test this, we cloned the promoter region of the cphBA operon and fused it to the beta-glucuronidase-encoding gene (gusA) from E. coli, and constructed a replicable plasmid pHLL71. We introduced pHLL71 into C. perfringens strain SM101 and collected samples from different time points during sporulation. By performing a GUS activity assay, we determined if the cphBA operon was turned on during sporulation and when it was activated. Approximately 5 hours after sporulation, an increase in transcriptional activity was observed, followed by decreased transcriptional activity at the end of sporulation. This initial data will help us understand the mechanisms associated with spore germination in C. perfringens SM101.

Mentor(s): Dr. Stephen B. Melville

53. Ashley M Thornhill

Characterization of BAS2560 and BAS4323 spore lipoproteins of Bacillus anthracis

Bacillus anthracis is gram-positive, rod-shaped and its spores cause the lethal disease, anthrax. In order for spores to complete germination and begin growth, it must contain spore lytic enzymes. Two interesting cells on the inner spore membrane are SleB and YpeB. SleB is a spore lytic enzyme and YpeB is thought to regulate SleB activity. The genes sleB and ypeB are expressed in an operon along with BAS2560. It is hypothesized that the proteins derived from BAS2560 and the closely related gene BAS4323 play a role in the collaboration between SleB and YpeB. These genes, BAS2560 and BAS4323, encode lipoproteins that are located on the inner spore membrane. Genes will be replicated for expression in E. coli. The proteins will be purified. Proteins will be assayed for direct interactions with SleB and YpeB in vitro, in hopes of elucidating the function of these genes. A heightened knowledge of spore germination can contribute to enhanced methods for spore decontamination and success towards controlling the disease.

Mentor(s):Dr. David Popham

54. Adam J Kleinman

Pancreatic Cancer Virotherapy: The use of Newcastle disease virus as an oncolytic agent against pancreatic adenocarcinomas

Pancreatic cancer is a cancer with one of the highest mortalities, showing a mean survival of 6 months using traditional therapies. Virotherapy, the use of selectively replicative and cytotoxic viruses in cancer treatment, is showing to be promising in the fight against cancer. The avian virus Newcastle disease virus (NDV) from the Paramyxoviridae family is oncolytic to human tumor cells while being safe for use as a cancer therapy, shown currently in Phase I/II clinical trials. Thus, our lab is investigating the oncolytic abilities of NDV in pancreatic tumor lines. We hypothesize that lentogenic recombinant LaSota NDV as well as mesogenic Beaudette C NDV strains will be oncolytic in the pancreatic adenocarcinomas cell lines, while not destructive to normal immortalized cell lines. To test our hypothesis, we are investigating the permissiveness and growth kinetics, cytopathic effects, cell viability, apoptosis induction, and interferon production by NDV in the pancreatic cancer cell lines.

Mentor(s): Dr. Elankumaran Subbiah

55. Lizette I Carrasco

Understanding the role of surface nano topography on bacteria-surface interaction, adhesion, and electron transport

Shewanella oneidensis MR-1 is a dissimilatory metal reducing bacterium that is able to form an electroactive biofilm on the anode surface of microbial fuel cells (MFCs). MFCs are regarded as a source of sustainable and renewable energy due to their ability to harness electrical energy from the catalytic reactions of electrochemically active microorganisms. Presently, MFCs are not able to operate on a large-scale commercial level due to their low power density output and thus, a wider usage of MFCs is dependent on improving system design parameters such as the anode surface. We hypothesize that nano-scale manipulations to the topographic profile of the anode may improve bacteria-surface interaction and adhesion thus causing denser biofilm formation which can facilitate higher and more rapid rates of electron transport ultimately leading to improved MFC performance. Topographically diverse anode surfaces were created by electrochemical etching of glassy carbon substrate masked with highly aligned and regularly spaced polystyrene nano fibers. Electrochemical performance was assessed after the introduction of S. oneidensis into a simplified three electrode half-cell through the use of potentiostatic measurement methods to determine the highest current generation resulting from multiple distinctive anode profiles of varying roughness. We believe that optimally nanopatterned surfaces will result in maximum adhesion density and power output.

Mentor(s): Dr. Bahareh Behkam

56. Mariah K Smith

The roles of three thioredoxins and a thioredoxin reductase in Methanococcus maripaludis

Methanarchaea are a diverse group of anaerobes that produce methane from simple compounds for their energy production. Oxygen is detrimental to methanongen. However, some methanogens are able to tolerate O2 exposure. The detail mechanism by which methanogens survive this oxidative stress is not well understood. To better understand this mechanism, we are investigating a class of small redox proteins called Thioredoxin (Trx). Trx plays important roles in many biological processes such as regulation of photosynthesis in plants. However the role of Trx in archaea is unknown. Our laboratory has recently studied the role of Trx in Methanocaldococcus jannaschii, a deeply-rooted methanogen, and discovered that Trx is likely used by M. jannaschii to protect a range of cellular processes against oxidative damage (1). We hypothesized that Trx helps methanogens to survive exposure to O2 which sometimes intrudes to their habitats. We will test this hypothesis by using Methanococcus maripaludis, a genetically tractable methanogen, which has three Trxs and a Trx reductase, as a model. We will construct M. maripaludis mutant strains lacking one or more of Trxs and determine their sensitivities to oxygen exposure. We will also determine the electron donor for the Trx reductase and characterize the protein.

Mentor(s): Dr. Biswarup Mukhopadhyay

57. Melissa Dobson

Catalytic Properties of two NADP-dependent Glucose-6-Phosphate Dehydrogenases of Mycobacterium smegmatis

Mycobacterium smegmatis is a gram positive non-pathogenic soil bacterium closely related to Mycobacterium tuberculosis. Both bacteria contain two NADP- dependent glucose-6-phosphate dehydrogenase (G6PD) genes, msmeg_3101 and msmeg_0314. The msmeg_0314 gene is located near the locus of the Entner-Doudoroff pathway (EDD) genes on the chromosome. It is speculated that msmeg_0314 plays a role in the EDD pathway. The msmeg_3101 gene is located near the locus of the pentose phosphate pathway (PPP) genes and potentially functions in the PPP pathway. Why each system will require a specific G6PD is not clear. One hypothesis is that the two enzymes have different catalytic properties which meet the specific needs of two pathways. To test this hypothesis the msmeg_3101 and msmeg_0314 coding sequences were amplified by the polymerase chain reaction (PCR) from M. smegmatis chromosome and cloned into an Escherichia coli over-expression vector. The recombinant proteins produced from this system in E.coli will be purified by chromatography and assayed for activity spectrophotometrically. For each enzyme the values of the Michaelis–Menten kinetic constants, Km for the glucose-6- phosphate and NAD(P) and Vm, will be determined and compared with that of the other.

Mentor(s): Dr. Endang Purwantini

58. Dajah E W Swinton

Temporal Analysis of Gene Expression during Quorum Sensing in the bacterium Pantoea stewartii

Pantoea stewartii subsp. stewartii is a Gram-negative bacterium that infects corn causing plant wilt. Exopolysaccharide production, which clogs the xylem and causes disease, is controlled by quorum sensing (QS). Quorum sensing (QS) defines how bacterial cells are able to communicate and coordinate their behavior in response to their environment. It is hypothesized that precise temporal control of gene expression permits P. stewartii to successfully cause infection in a plant. The goal of this research is to generate transcriptional fusions of P. stewartii gene promoters with reporter green fluorescent protein (GFP), to analyze the expression patterns of genes controlled by EsaR. Promoter regions of the genes, dkgA, esaI, osmY, and uspA were amplified with PCR and ligated into the cloning vector, pGEM, followed by transformation of E.coli with the plasmids. The cloned PCR product was sequenced to check for mutations. Subcloning of the promoter into vectors pPROBE'-gfp[LAA] and pPROBE'-gfp[tagless] results in transcriptional fusions between the promoter region and GFP. The conjugation of the transcriptional fusion into P. stewartii, allows analysis of the patterns of promoter expression. This work will provide insights into the timing of the expression of individual genes known to be part of the QS response in P .stewartii.

Mentor(s): Dr. Ann M Stevens

59. Mazoe Morris

Identification and Isolation of Antimicrobial Producing Microbes from Soil

In the past, antimicrobials produced by organisms found in the soil have been proven to be very effective antibiotics in treating pathogens. Over time, the very substance that was meant to be a cure for some human diseases became useless as pathogens developed resistance. The overuse of antibiotics for example, Penicillin, caused these pathogens to develop resistance towards the antibiotics; and even with a stronger dose of antibiotics will bring about more harm than good. Previous researchers have discovered that the bacteria most used for antibiotic production are species of Bacillus and Streptomyces as well as fungal strain such as Penicilliam Cephalosporium due to the competitive environment they live in. In this current research, I plan to explore soil bacterium and fungi's ability to produce new antimicrobials from regions of the New River Valley. Soil samples would be collected near ponds trees, and sewage plants. Potential antimicrobials produced by such isolates would be tested against normal as well as drug resistant organisms using conventional methods.

Mentor(s): Dr. Nammalwar Sriranganathan

Oral Presentation Session 4 2:45-4:00

Jacquline C Plyler

Biofabrication of Suspended Fiber Force Nanonets within Microfluidic Hydrogels for the Investigation of the Influences of Salmonella typhimurium Enterotoxins on Glioma Models

Salmonella enterica serovar Typhimurium characteristically expresses powerful enterotoxins within its environment, which trigger a host's immune response. Though often associated with food poisoning, S. Typhimurium's enterotoxins propose a potential therapeutic effect in glioblastoma multiforme treatment. To further investigate the efficacy of this innovative prospect, force fiber nanonets were integrated with a hydrogel microfluidic device to fabricate an in vitro model resembling the native extracellular matrix (ECM) environment. The non-electrospinning Spinneret based Tunable Engineering Parameters (STEP) technique was used to manufacture suspended and aligned polystyrene nanonets, permitting the investigation of single-cell force deflections. The three-channeled hydrogel microfluidic device allowed for the inoculation of S. Typhimurium within the outer channels, and the seeding of DBTRG-05MG glioma cells within the center channel onto the secured nanonets. The porous structure of the PEG-DA hydrogel walls allows for the diffusion of S. Typhimurium enterotoxins. The effects of increasing time lengths with variable bacterial concentrations on single cell migratory and adhesive forces can be quantified through changes in fiber deflection. This platform provides a revolutionary method of observation of simultaneous roles of biochemical and biophysical cues, furthering future bacteriotherapeutic cancer treatment research studies in appropriately modeling the ECM's properties..

Mentor(s): Dr. Bahareh Behkam

Stacie M Zwolski

Factors that Contribute to Variation in the Material Properties of Human Liver and Spleen Parenchyma between Individuals: Evaluation of Age, Weight, Height, and Histology

The liver and spleen are the most frequently injured solid organs in automotive collisions. Although recent studies have quantified the material response of human liver and spleen parenchyma, factors that contribute to inter-subject variation are not well understood. This study evaluated potential correlations between human liver and spleen material properties, obtained from tension and compression tests performed at four different loading rates, and age, weight, height, and histology (i.e. liver and spleen fibrosis, liver lipid content, and spleen smooth muscle content). In addition, a second-order Mooney-Rivlin model was employed to model each test. Based on an initial evaluation of a portion of the histological data, fibrosis was positively correlated to elastic moduli and peak stresses for high strain rate liver compression tests, and all rates for spleen tension tests. For spleen compression tests, fibrosis was negatively correlated to elastic moduli and peak stresses, while the opposite trend was found with respect to smooth muscle content. However, these trends may change with the addition of the remaining histology data, currently being analyzed. Age, weight, and height data are also being evaluated with respect to material properties and histology. These results provide insight into factors contributing to inter-subject variation in the liver and spleen material response, which may aid in the development of subject-specific models for injury risk assessment.

Mentor(s): Dr. Andrew Kemper

Lauren M Severance

The Effects of Blast Exposure on Cell Membrane Permeability

As the use of explosive devices increases in military combat, blast-induced traumatic brain injury (bTBI) has become more common, and currently, there is increasing interest in understanding the mechanisms behind bTBI on the cellular level. This research was conducted in order to determine if the increase in cell membrane permeability as a result of blast exposure is due to membrane poration and if so, to gain an understanding of membrane pore size. Membrane poration was determined by uptake of fluorescent microspheres (FluoSpheres®) by cells. FluoSpheres® were incubated with glial cells in 6-well plates. The cells were exposed to a blast using a novel benchtop blast simulator, excess culture media removed, and the cells washed and lysed. Fluorescent spectroscopy was used on the lysate to determine fluorescence, indicating FluoSphere uptake by cells. The intensity of fluorescence was converted into FluoSphere® concentration. The number of cells surviving in each well after the blast was determined using a BCA assay. FluoSphere® concentration was normalized to the total protein concentration for each well. Preliminary results show an increase in FluoSphere® uptake in cells exposed to blast as compared to sham controls, indicating membrane poration in blasted cells. These results may be beneficial in future work regarding drug delivery in patients with bTBI.

Mentor(s): Dr. Pam VandeVord

Keegan M Yates

Statistical Shape Analysis of the Spleen

The spleen is one of the most commonly injured organs in collisions. A statistical shape model is necessary to take into account inter-individual variation in spleen geometry. The objective of this study was to develop a landmark sliding algorithm which minimizes the errors of corresponding landmarks across the population. An algorithm was written to perform a Procrustes analysis which aligns the target specimens to a specimen selected as the template. First, the points on each target that are both close to, and have similar surface normals to evenly distributed points on the template are identified. The algorithm next iteratively slides the landmarks to minimize the shape correspondence error. Finally, a principal component analysis is done to find the main modes of variation. This landmark sliding method was able to produce a statistical shape model with better generality, specificity, and compactness, and accuracy than without the landmark sliding. The first five modes of variation account for 79% of the spleen variation. In the future, a statistical shape model of the spleen could be implemented in human finite element models to better understand the injury mechanisms and develop advanced restraint systems.

Mentor(s): Dr. Costin Untaroiu

Casey D Patnode

Effects of Mechanobiology on Glioma Ablation Using High Frequency Electric Fields

The goal of this project is to analyze the effect of the extracellular environment on brain tumors and their treatment. The vast majority of research concerning cancer focuses on the interior of the cells, their composition, mutations, etc. Cancer, however, is extremely variable and the same type can have different mutations and genetic info across different tumors or even in different areas in the same tumor. This study examines the extracellular environment by growing tumors in different concentrations of 3D alginate hydrogels, which span the range of normal to tumorous brain tissue. In order to simulate a treatment method, electroporation using H-FIRE (high frequency irreversible electroporation) and IRE (irreversible electroporation) are used. Traditional surgical methods tend to be relatively ineffective in treating brain cancer as the tumor can spread into the brain tissue and cutting them out may damage surrounding brain tissue, which could cause severe harm to the patient. By inducing an electric field using embedded electrodes, the tumors can be killed without damaging surrounding tissue, as demonstrated by live/dead assays of the cells. The range of hydrogel stiffness allows for the isolation of that effect on selectively killing tumor cells. The results show that the extracellular environment does impact the cell and that this treatment is a viable method..

Mentor(s): Dr. Scott Verbridge

Mariah Haberman

A Full Investigation and Water Quality Report of Beaverdam Reservoir, a Critical Drinking Water Resource for Roanoke, VA

To best manage our drinking water resources, it is imperative to define the physical characteristics of a reservoir, as well as monitor its chemistry and biology. For this project, we investigated the water quality of Beaverdam Reservoir (Blue Ridge, VA), a reservoir that flows into a drinking-water source managed by the Western Virginia Water Authority. Although Beaverdam Reservoir provides a critical water resource for the residents of Roanoke, VA, its detailed water quality remains unknown. From April, 2014 through July, 2014 we monitored depth-profiles of conductivity, temperature, dissolved oxygen, chlorophyll a fluorescence, phytoplankton pigments, and pH. Additionally, we collected water samples to analyze phosphate, nitrate-nitrite, and ammonium concentrations. The time series of some of these data show seasonal variance. For instance, as summer progressed, we observed a substantial decrease in dissolved oxygen concentrations above the reservoir sediments, until anoxic conditions were observed not long after the onset of thermal stratification. In addition to water quality monitoring, we constructed the first-ever bathymetric map of the reservoir using Acoustic Doppler Current Profiling (ADCP) and determined the surface area and volume of the reservoir. These data were then used to determine the thermal stability of Beaverdam and the potential nutrient loads flowing out of Beaverdam into the drinking water supply.

Mentor(s): Dr. Cayelan Carey

Jamie R Keyes

Benefits of Greywater Systems in Third World Countries: Special Focus on India

Water is the most important resource on Earth, without water there would be no life. With that statement in mind there are almost one billion people who don't have access to clean drinking water. Therefore it is extremely important to find ways to provide access to clean drinking water to people around the world. One of the best ways of doing so would be to use the water available more efficiently. Greywater filtration systems are an efficient way to reduce the amount of potable water needed within a home, business, or industry. The greywater would be passed through a filtration system after which it can be used as water for toilets, irrigation, and gardens hence reducing the demand for drinking water that is being used for such functions. This increase in efficiency could lead to clean water being available to more people. The purpose of this research project is to determine the possible benefits of installing greywater systems in third world countries in Africa and Asia; while using India as an example. A literature review was conducted in order to determine the different types of greywater systems, the efficiency of greywater systems in reducing the amount of clean water initially used, and the benefits that these systems can provide in third world countries.

Mentor(s): Dr. Akshay Sharma

John Purviance

Python based serial data acquisition on Raspberry Pi

The Learning Enhanced Watershed Assessment System (LEWAS) is a high-frequency water and weather monitoring lab on VT campus with three primary environmental sensors: an Acoustic Doppler Current Profiler, Water Quality Sonde, and a Weather Station. The goal of this study is to develop and implement a Linux based system with a Raspberry Pi that will allow users to access high-frequency real time LEWAS data for education and research.

Shell scripting on a Raspberry Pi controls modular Python programs for each sensor that start data collection, parse received data stream and store data points in a local database on the Raspberry Pi in real time before terminating data collection. A local database on the Raspberry Pi utilizes a mirroring process to replicate the local database to a remote database established for the LEWAS data. Users will access the remote database using various utilities to use the LEWAS data for research and education. Use of the Raspberry Pi system allows the LEWAS team to use a common hardware and software environment to collect, process, store and manage high frequency data and thus giving advantage over using the individual proprietary software for each sensor.

Mentor(s): Dr. Vinod Lohani

Melissa Wilson

Solubility and Dissolution Rate of Lead Particles

The corrosion of lead pipes, brass fixtures, and lead based solder are significant sources of lead in drinking water. As such, controlling plumbosolvency and release of lead is a goal of all water utilities. Lead solids such as lead oxide, lead carbonate, and lead phosphate, form as protective scales on lead pipes. Since lead concentration in water is higher in the summer, it is hypothesized that lead solubility increases with temperature. However, other factors such as the presence of iron in water can lead to more particulate lead. This study aims to examine the influence of temperature and the presence of iron on the dissolution of three different lead solids. Determining the dissolution rate and equilibrium solubility of each of these lead solids can indicate seasons and locations that could have increased lead in water and thus an increased risk for lead poisoning. To test the effect of temperature and iron on the lead solids, bench-scale tests were conducted in which each lead solid was synthesized and collected on a filter, then placed in batch reactors. Dissolved samples were collected by filtering 10 mL aliquots through a 0.1 μm filter. Metal concentrations were analyzed using inductively coupled plasma mass spectrometry.

Mentor(s): Dr. Marc Edwards

Kara M Harrison

Legionella Pneumophila Growth in Simulated Water Heaters Under Stagnant Conditions

Legionella pneumophila is an opportunistic pathogen which has been found to thrive in pipes and fixtures at the building level of the distribution system (premise plumbing). L. pneumophila can cause Legionnaire's disease in immunocompromised individuals and hospitalizes 8,000 to 18,000 people a year with a fatality rate of 5-30%. It is believed that L. pneumophila prefers to grow in stagnant water conditions although what conditions lead to proliferation are still unknown. The goals of this experiment were to determine (1) which materials in premise plumbing lead to higher levels of L. pneumophila growth, specifically during a stagnation period and (2) whether the amount of total organic carbon had an effect on L. pneumophila growth during a stagnation period. The experiment was performed using previously established simulated glass water heaters inoculated with L. pneumophila as well as other organisms typically found in a premise plumbing microbiome. The amount of L. pneumophila growth was calculated by extracting the DNA in effluent water from the reactors and performing quantitative polymerase chain reaction (qPCR) on the DNA. The effluent water was also cultured on a charcoal agar designed for L. pneumophila to further confirm that the pathogen was alive and proliferating in the reactors.

Mentor(s): Dr. Marc Edwards

Lauren L Wind

Assessing Reactivity of Nanoiron through a Colorimetric Assay, SPME-GCMS, and Thiobarbitutric Acid Reactive Substances

Nanoiron materials are widely being used for groundwater remediation and in the future, could be used in food engineering. However, more information is needed about the reactivity of these materials. The objectives of this research were: 1) to determine the reactivity of ferrous sulfate (II) (FeSO4) and new and aged Zerovalent Nanoiron (nZVI) to produce ferrous ions using a colorimetric assay; and 2) react iron materials with saliva and then measure iron-induced salivary lipid oxidation inculding hexanal by Solid Phase Micro-Extraction (SPME-GC-MS) and malondialdehyde by Thiobarbituric Acid Reactive Substances (TBARs). Results show that FeSO4 produced 100% ferrous ions, new nZVI produced 52% ferrous ions, and old nZVI produced 92% ferrous ions in solution. Salivary lipid oxidation byproducts from iron materials revealed that FeSO4 induced more hexanal than aged nZVI or new nZVI. FeSO4 produced more MDA than old nZVI, and new nZVI induced the least MDA. This study aims to assess the reactivity of FeSO4 and nZVI in human saliva and the implications to health and aesthetic issues in drinking water.

Mentor(s): Dr. Andrea Dietrich

James F von Dollen

Hormones in the Stroubles Creek Watershed

The use of animal manure to fertilize soil has been a common practice, but its environmental impact has not been thoroughly questioned. Our study focuses on soil samples that were collected over the period of one year from animal manure-applied to Hethwood farms to determine the impacts of such a practice. Eleven hormones are suspected to be in the soils due to the application of manure including: Estrone, 17α-Estradiol, 17β-Estradiol, Estriol, Progesterone, Estrone-3-Sulfate, Estrone-3-Glucorinide, Estradiol-3-Sulfate, Estradiol-3-Glucorinide, 1,4-Androstadiene-3,17-dione, and 4-Androstene-3,17-dione. The effects of hormones on our environment can be detrimental to fishes including various health issues such as sex changes and birth defects. It is thought that these hormones accumulate in depressions as they are being washed away from ridges and swales of the farm. Hethwood farm is also located directly along the side of Stroubles Creek in Blacksburg, Virginia; thereby possibly affecting the health of the nearby stream and the watershed. Our study determines the concentration of the hormones and where they are in relation to run off. High Pressure Solvent Extraction and Solid Phase Extraction were used for sample extraction and clean-up. High Performance Liquid Chromatography/Triple Quadrupole Mass Spectrometry was used for analysis of compounds of interest.

Mentor(s): Dr. Kang Xia, Theresa Sosienski

Mariah K Redmond

Release potential and mobility of sediment phosphorus in a periodically oxygenated

Phosphorus (P) is a limiting nutrient for cyanobacteria, bloom-forming phytoplankton that threaten drinking water quality because of their scums, toxins, and odors. Excessive P in water can cause cyanobacteria to bloom. Oxygen, which controls P availability, is consumed in the decomposition of cyanobacteria. The cycle of oxygen depletion by cyanobacterial decomposition, P release into water due to low levels of dissolved oxygen, and further bloom proliferation due to increased P in the water column is called eutrophication. Release of P from sediments to water is thus a critical process to quantify for evaluating potential for cyanobacterial blooms. P can be bound to different sediment fractions, including minerals and organic matter. The concentration and affinity of P to these fractions influence P release into the water column. For this study, I analyzed P fractionation in sediment cores from Falling Creek Reservoir, a drinking water source in southwestern Virginia. The reservoir is periodically oxygenated. Cores were collected under both oxic and anoxic conditions. At selected depths in each core, I analyzed the following P fractionations: mobile, bound to iron and aluminum, associated with organic matter, and bound to calcium, carbonates, and apatite. Results of my work will shed light on the mobility of P in sediments under different controlled oxygen conditions, with the ultimate goal of preventing cyanobacterial blooms in reservoirs.

Mentor(s): Dr. Madeline Schreiber

Savannah E Cranford

Bio Inspired Water Stewardship

Can fog capture really make a difference in the water needs of people, specifically in third world countries? This is the main question for the following research. As such the goals of the project were to do a global survey of fog capture and fog capture regions of opportunity, analyze current fog capture designs, investigate possible alternatives to netting and propose different design improvements. Fog capture is an old technology that is being looked into more this century due to the growing demand for water. According to the UN "783 million people do not have access to clean water", with this amount fog capture should be considered for assistance. Research was conducted by reading about field conditions in locations, questioning experts such as FogQuest about issues with designs and suggesting improvements. We are hoping the outcome of this research supports the idea that fog capture can have a greater impact to secure water access, especially in areas where there can be no wells or other sources of water capture. Lastly, this research is evidence of the continual need for investigations in the area of fog capture, with a possible expansion into dew capture, and other technologies applicable to water capture.

Mentor(s): Brook Kennedy

Steven T Keith

Quantification of Distinguishing Features of Tsunami Versus Hurricane Sediment Overwash Events

Identifying the difference between hurricanes and tsunamis is an important task in locations where the two events commonly occur. There are a wide variety of methods to distinguish the two types of events from the geologic record; however, these methods are not always sufficient. There is a very small sample size of events to determine the intensity of paleo-events for frequency models to protect and inform coastal regions due to the difficulty to collect data from either event and to differentiate the two. With a quantifiable difference between hurricane and tsunami deposits it will be possible to study paleo-events and use the data to build a better model to predict their return periods. This paper will investigate sediment transport from an idealized barrier island with XBeach, a model for extreme beach conditions, using a series of hurricanes of varying sizes and tsunamis of a comparable magnitude (1:100). Hurricane parameters will be varied while only the tsunami wave heights will vary to keep the energy ratio consistent. In general higher surge levels produce a larger amount of erosion and when coupled with large waves the island erodes away. The respective tsunamis exhibit similar behavior but transport sediment farther than storms.

Mentor(s): Dr. Jenifer Irish

Paige M Szymanski

Single Cell Aspiration for Leader Cell Molecular Profiling

Metastasis occurs when cells break away from tumors and travel to other parts of the body. It is unclear what triggers these cells to break away and take on leader-like phenotypes before migration. Thus, it is critical to develop technologies which mimic in vivo environments and promote the formation and allow collection of leader cells for detailed molecular profiling. Here we demonstrate extra-cellular matrix resembling suspended fiber nanonets approaching diameters of natural collagen bundles (400-800nm) used to induce leader cell formation. Once formed, leader cells are selectively aspirated using micropipettes for detailed biologics. The major challenge faced with this method is aspirating pressure calibration to minimize cell damage. To calculate pressure, force of adhesion of single cells adhered to the fiber must be determined. To do this, a ligand coated probe is brought in contact with the cell and over time, adhesions form. The probe is subsequently retracted causing deflection of the fiber. The experimentally measured deflection at cell detachment from the fiber provides the force of adhesion using beam mechanics. Using this, we aim to quantify cell survival following aspiration for cells attached to fibers of different diameters signifying altered focal adhesion patterns and adhesion strengths. Isolation and molecular profiling of leader cells is crucial in the advancement of our fundamental knowledge of metastasis and also in developmental and repair biology.

Mentor(s): Dr. Nain

Whitney M Tatem

Factors which Affect Frontal Impact Thoracic Injury Risk for Belted Crash Test Dummies

In passenger vehicle collisions, impact to the occupant's thorax may occur through contact with the interior of the vehicle, especially the steering wheel, but also through contact with the airbag and seatbelt. These occurrences can lead to serious and sometimes fatal injuries. Frontal crash tests show that the ability to protect an occupant from thoracic injury varies widely by vehicle. The objective of this study is to identify which crash characteristics most greatly influence thoracic injury risk in full frontal vehicle impacts. This study evaluated 52 model year 1998 and 40 model year 2014 vehicles subjected to 35 mile-per-hour full-frontal rigid barrier crash tests with airbag deployment and seatbelt usage conducted by the National Highway Traffic Safety Administration (NHTSA). Multiple logistic regression was used to correlate combinations of chest compression, 3 millisecond clip, maximum longitudinal change in vehicle velocity (delta-V), peak occupant compartment acceleration, crash test dummy positioning and size, maximum lap and shoulder belt loads, and the presence of a seatbelt load limiter and/or pretensioner to the maximum crash test dummy chest acceleration. The best combination of metrics to predict chest acceleration will be presented at the symposium. The results of this study have the potential to guide further research into improved safety equipment and restraints for future vehicles.

Mentor(s): Dr. H. Clay Gabler

Juliette D Parks, Michael A Harring

The Effects of Binaural Stimulation on Brainwave Entrainment

An experiment was conducted to determine if binaural stimulation can induce brainwave entrainment in order to improve productivity and focus. Binaural stimulation is the process in which two tones of slightly differing frequencies are individually presented to the left and right ear. This results in a third low-frequency binaural beat, created within the cortex, equal to the frequency difference. Brainwave entrainment occurs when the electrocortical activity oscillates at the frequency of the binaural beat. Clinical trials were run between periods of 10 and 40 minutes where the subject was presented with binaural beats of varying target frequencies, wave patterns, and ier frequencies. EEG data was collected using a 14 channel Emotiv EEG headset at a sampling frequency of 128 Hz. While no conclusive evidence of entrainment has been observed in the initial results, variables such as sawtooth wave modification, 5 Hz and 7 Hz target frequencies, and carrier frequencies of 240 Hz and 480 Hz have displayed periods of desired frequency activity. Further research could allow for binaural stimulation applications ranging from increased studying efficiency to short-term memory enhancement.

Mentor(s): Dr. Alexander Leonessa

Anthony Berlinbach, Alejandro Perilla, Alexandra Patterson

Research to Market- The roll of a Tech Transfer Office

Our research this summer was conducted at the Virginia Tech Intellectual Property office, which serves as VT's tech transfer office. VTIP serves as the link between the research conducted at Virginia Tech and the commercial world. The processes of taking an invention developed by a Virginia Tech student or faculty member can be broken up into three main steps- first extensive searching is conducted in order to prove the originality of the new technology. Novelty is crucial to the patentability of a technology; meaning that VTIP must conduct a thorough prior art search in both existing patents and already published papers. Next VTIP must protect the new technology in the US or internationally. This processes starts by teaming up with patent attorneys and drafting a patent application to be reviewed by the United States Patent Office. If a patent is issued, VTIP must then work on licensing the patented technology to businesses. This is done through market research in the patents respective field and developing a list of companies and contacts within the companies to market the technology to. VTIP requires its workers to have a broad understanding of different engineering fields along with life sciences, in order to be able to work with the inventors to gain a patent on their work. Working at VTIP we were exposed to the link between University research and businesses.

Mentor(s):John Geikler

William Scally

Comparison of Flow Computation Methods in an Urban Strom Water Network

Computing flow in urban stormwater networks is important because it is necessary to understand pollutant loads, record urban water flow, and monitor the efficiency of our urban stormwater infrastructure. One specific method to compute flow is the index velocity method which relates the index velocity given by an acoustic Doppler current meter to the mean velocity of the channel. This method however does not take into account the vertical cell velocity profiles recorded by the current meter. This paper seeks to improve upon the index velocity method by relating the cell velocities of a Sontek Argonaut-SW Acoustic Doppler current meter to the mean velocity recorded by a handheld Sontek FlowTracker as well as the discharge computed through a stage-discharge weir rating curve. Stage behind the weir is recorded by a Global Water WL705 ultrasonic level transducer. Data was collected over the span of 10 weeks at a location on Stroubles Creek south of West Campus Drive on Virginia Tech campus in Blacksburg, VA. Results from this study are expected to improve the index velocity method by relating individual velocity cells from the index velocity profile to the mean velocity given by the ADV and flow given by the weir.

Mentor(s): Walter McDonald

Erica M Davis, Nicole Carter, Karla Boza

Human Values and Water Quality

The objective of this research project is to identify and map social values associated with the Stroubles Creek watershed. This information is essential for designing effective outreach and awareness programs, as well as management practices that provide the most ecological and social benefits to the surrounding area. A randomly selected representative subsample of the Blacksburg community was surveyed and asked to identify valued surface water features and assign social values to each location. Other survey questions probed the level of contact with each location, stakeholder responsibility, and willingness to pay for water quality. The findings will be compared to recent water quality data to test for correlations between water quality and a feature's aggregate value. Preliminary data indicates there is a discrepancy between the respondents' perception of Blacksburg's water quality and the actual condition of Stroubles Creek. Respondents tend to value certain features, such as the Duck Pond, more frequently than other locations. Additionally, certain values, such as aesthetic, recreation, and environmental value, are identified on a more frequent basis. These findings indicate that water features are not equally valued by residents, but almost all respondents place importance on the issue of water quality. Another common theme is a desire for more information and awareness, as well as ways to get involved in improvement projects and campaigns.

Mentor(s): Dr. Meredith Steele, Dr. Luke Juran, Dr. Mike Scorice, Dr. Leigh-Anne Krometis

JaymeLee Ewing, Caleb Higgenbotham, Cort Hammond

The Distribution of Nutrients in Urban and Agricultural Ponds Used in Determining the Cost Effectiveness of a Biochar Filter BMP

Retention ponds are common best management practices (BMPs) used to limit nutrient loading of streams and bays. Nutrients can lead to eutrophication and phosphorus is of particular concern as a growth-limiting nutrient for freshwater algae. These nutrients are transported by both stormwater runoff and agricultural drainage; to study the full range of these two sources, two urban ponds, two agricultural ponds, and one golf pond were sampled. The concentrations of total and dissolved phosphorus and nitrate, dissolved sulfate, organic carbon, and iron were determined for water samples of five retention ponds at incremental depths in order to estimate the distribution, quantity, and cycling of phosphorus. We hypothesize that depth influences the quantity of phosphorus due to a gradient of oxygen content, pH, or light intensity. Because the saturation of retention ponds with phosphorus results in decreased removal rates of phosphorus; these results are applied to our assessment of the cost effectiveness of a biochar filter used to reclaim phosphorus as a useful fertilizer and rejuvenate retention ponds. Phosphorus-rich pond water may be applicable to the conditioning of biochar for agricultural application, a process that may increase the value of raw biochar by as much at two times.

Mentor(s): Dr. Cully Hession, Stephanie Houston, Dr. Ryan Stewart

Christine H Hart, Sarah Medley, Andrea N Stewart

Using microbial source tracking to identify sources of human fecal contamination in a small urban watershed

Surface waters contaminated with fecal pollution represents a public health risk from the potential transmission of human pathogens. However, fecal indicator bacteria (FIB), which have been traditionally used to assess microbial water quality, cannot distinguish between animal and more threatening human inputs. Previous research at one site on Stroubles Creek observed consistently high levels of a new genetic marker for human Bacteroides (BacHF183) during storm events, which is highly indicative of the presence of sewage contamination. This project aims to survey the watershed in an attempt to locate potential sources of contamination, including both surface waters and stormwater infrastructure, to identify areas that may require infrastructure inspection and repairs. Duplicate water samples were collected from 42 sites across the watershed. Concentrations of two commonly used FIB, E. coli and enterococci, were determined using most probable number, and quantitative polymerase chain reaction was used to measure the concentration of the BacHF183 marker for each sample. Geospatial analysis was utilized to identify hotspots of suspected human fecal contamination, and these locations were resampled at a finer scale. Expected benefits include a better understanding of the performance of BacHF183 concentrations for tracking contamination sources spatially and recommendations to improve water quality in Stroubles Creek and Blacksburg's Total Maximum Daily Load implementation plan.

Mentor(s): Dr. Meredith Steele, Dr. Brian Badgley, Dr. Leigh-Anne Krometis, Dr. Ryan Stewart, VT-Site & Infrastructure Development(Dietz, Cooper, Grimes, Junco), Town of Blacksburg(Kafi Howard)

Brianna K Swartwout

The role of Tollip in inflammatory priming of murine macrophages by LPS

Lipopolysaccharide (LPS) is a putative component of Gram negative bacteria and highly studied for its role in chronic inflammatory conditions. As a ligand for Toll-like receptor 4 (TLR4), LPS primes the innate immune system for septic shock at low doses by activating the pro-inflammatory arm of TLR4's signaling mechanisms. Tollip is a signaling molecule in the TLR4 pathway and is believed to dampen the pro-inflammatory response, especially with low doses of LPS. We believe that Tollip plays a regulatory role in priming the innate immune system by interacting with the JNK/ERK pathways. To test the effects of Tollip on inflammatory priming, monocytes from wild-type (WT) and Tollip -/- mice were cultured to modulate their differentiation into macrophages when chronically exposed to low doses of LPS. Flow cytometry revealed elevated expression of CCR1 and CCR5, receptors that recruit leukocytes in inflammation, and MCP-1 and MIP-1α, pro-inflammatory chemokines, in Tollip -/- cells. We found significant difference in CCR1 expression at 10ng and 1ug of LPS (p-values 0.015 and 0.00013) and in CCR5 expression at 100pg, 10ng and 1ug (p-values 0.0062, 0.039 and 0.043). Preliminary data shows MCP-1 and MIP-1α expression is more pronounced in Tollip -/- cells at 100pg (p-value for MCP-1: 0.0067). Our data supports Tollip as a negative regulator of inflammation, and an inhibitor in innate immune priming.

Mentor(s): Dr. Liwu Li

David Mason

Drone on the Range: how low until I can shoot?

Drones, or Unmanned Aerial Vehicles (UAV), are beginning to transition from government and military use into commercial markets with an expected 80% of use going to agriculture. However, the FAA has banned the use of them for commercial purposes while they develop regulations to safely integrate them into national airspace. While their main concern is safety many people and organizations are worried that privacy will not be properly addressed.

The unique flight capabilities of UAV make them a highly valuable tool in agriculture. These same characteristics also test current property and privacy rights and previous court cases, which may be found obsolete and in need of updates through either new legislation or new lawsuits. This paper explores precedent court cases and the current state of legislation and drone technology to try and explain the possible limits of UAV users in agriculture and other industries.

Mentor(s): Dr. Leon Geyer

Wonjae P Kim

Seeding an Invasion: Resource-based Propagule Pressure

Weeds and invasive species devastate natural ecosystems and agronomic systems globally. Johnsongrass (Sorghum halepense), one of the worst invasive plants in industrial, urban, and agricultural systems, uses two reproductive systems to spread and establish in new areas. Unfortunately, no studies have attempted to investigate how resource allocation to Johnsongrass' two reproductive systems (i.e., rhizome and seeds) can affect establishment success. Here, we determine how reproductive carbon allocation influences establishment and eventual invasion success in contrasting environments. We introduced the same amount of tissue carbon, ranging from 0.5g to 10g in the form of seeds and rhizomes to bare ground or resident plant communities in replicated plots in two locations. The number of Johnsongrass individuals that emerged, percent cover of Johnsongrass, other grasses, broad-leaf weeds, and bare ground, light penetration, and flowering individuals was recorded bi-weekly. Our results suggest rhizomes have 400% more emerged individuals while seeds occupied eight times more ground cover. These two carbon investments have advantages depending on the environment. Seeds thrive better in areas devoid of plants while rhizomes overcome competition stress better. Understanding how Johnsongrass establishes and invades through multiple reproductive systems will lead to better invasion prevention of this invader.

Mentor(s): Dr. Jacob Barney

Justin Hall

Small mammal communities of hemlock forests in Virginia

Vegetation types and moisture conditions are known to influence small mammal diversity and density in the Southern Appalachians. To determine if these conditions influence habitat use by small mammals in a riparian hemlock forest, I conducted a study measuring species diversity and density in a stand of riparian hemlock and an adjacent upslope northern hardwood forests at Cascades, Giles County, VA. I used live-trapping method on a 5 X 5 grids (N=25) of Sherman traps placed in the red spruce and northern hardwood stands, simultaneously. Captures were identified to species, sexed, weighed, measured, and marked. I anticipate that due to the small patch size of hemlock, there will be similar species density and diversity within the hemlock stands and the adjacent northern hardwood forests at my study site.

Mentor(s): Dr. William Mark Ford

Whitney H Beasley

Serum Lipid Profiling by Liquid Chromatograpy-Mass Spectrometry

There is intense interest in the biomedical community centered on the identification of biomarkers associated with disease and stress states. As most biomarkers are transported through the bloodstream, serum (cell-free blood that is devoid of coagulants) is often used as a starting material for biomarker work. Our goal was to develop a robust Standard Operating Protocol (SOP) for analysis of lipid-based serum metabolites for a wide range of species. We analyzed the lipids present in the serum of the large aquatic salamander Cryptobranchus alleganiensis (hellbender), a species endemic to the eastern United States. Both male and female serum samples were processed to extract the lipids from serum proteins and water-soluble metabolites by liquid-liquid extraction. The resulting extract was analyzed by liquid chromatography-mass spectrometry (LC-MS) and statistically analyzed to identify key biomarkers for males, females and stress. Several hundred ions (or features) were obtained in these investigations, leading to the first lipid map of the species.

Mentor(s): Dr. Richard F. Helm

Mahtaab Bagherzadeh

How do Changes in Plant Species Dominance Influence Nitrogen Cycling and Soil Communities in Southern Appalachian Forests?

Density of the native evergreen shrub rhododendron (Rhododendron maximum) has increased in southern Appalachian forests in recent decades. These changes are associated with major shifts in forest community composition beginning with the loss of Chestnuts (Castanea dentate) early in the 20th Century, ongoing logging since the 1870s, and most recently with the loss of eastern hemlock (Tsuga canadensis) due to the invasion of the hemlock woolly adelgid (Adelges tsugae). Such changes in dominant vegetation may result in loss of local biodiversity, changes in soil ecosystem functioning, food webs, and hydrology. For example, rhododendron proliferates clonally resulting in thick, close-canopied thickets typically located in riparian zones of headwater catchments (i.e., "hells"), and due to the low quality of rhododendron leaf litter has been shown to significantly reduce rates of decomposition and nutrient cycling. The objective of this study was to examine the influence of rhododendron on soil biology and biogeochemical cycling in Southern Appalachian Watersheds (located in the Nantahala National Forest in western North Carolina). Sites were selected to include plots that are thickly inhabited by rhododendron growth and those that have no or very low rhododendron presence. Here I report preliminary results documenting the influences of rhododendron on soil nutrient content (carbon and nitrogen) and microbial biomass. Results are anticipated to reflect more robust soil microbial communities in areas bereft of rhododendron overgrowth, accompanied with elevated amounts of available nitrogen. This work will address the effects of changes in biodiversity and alterations of ecosystem services and the inevitable impact on soil and water quality.

Mentor(s): Dr. Jeb Barrett

Michael K Jones

Biochemical characterization of MJ1099 gene product for methanofuran biosynthesis in Methanocaldococcus jannaschii

Methanogens use a variety of methanogenic coenzymes to reduce carbon dioxide to methane, producing 350 million tons of methane a year. The biosynthetic pathway and the associated genes are being determined for the biosynthesis of the 4-hydroxymethyl-2-furancarboxaldehyde phosphate (4-HFC-P) intermediate in the pathway of methanofuran, a methanogenic coenzyme, in the methanogenic archaeon Methanocaldococcus jannaschii. The recombinant gene product of the MJ1099 gene (MfnB) has been known to contain a class I aldolase domain, and has been shown to condense glyceraldehyde-3-phosphate (GA-3P) to form 4-HFC-P. To confirm the formation of 4-HFC-P, a known standard curve of 5-HFC molar absorptivity was used to calculate 4-HFC-P concentration using UV-vis spectroscopy. A pH-dependent study was conducted, measuring 4-HFC-P product formation at varying pH from 4.0-11.5, showing that MfnB exhibited the highest activity at pH 7.0. Steady-state kinetic study was also performed to evaluate the catalytic ability of MfnB. The kinetic constants followed Michaelis-Menten kinetics, a Km = 0.05 mM, kcat = 0.02 s-1 were obtained. To further characterize the function of MfnB, the site-directed mutagenesis study was conducted; five variants of MfnB were cloned, expressed, and purified. Of those, D25N, K27R, K85R and D151N have been shown to be completely inactive, while K155R variant showed an approximately 80% decrease in kcat.

Mentor(s): Dr. Robert White

Poster Presentation Session 5 2:45-4:00

1. Magdalina L Moses

Experiment Design to Assess Ionospheric Perturbations During a Solar Eclipse

In 2017 there will be a total solar eclipse over the United States traveling from Washington to South Carolina. The objectives of this study are to determine what ionospheric changes we expect to observe during the eclipse, and to devise an experiment to make appropriate observations. Solar eclipses offer a way to make observations on the dependence of the ionosphere on the sun's radiation. There are significant differences between the conditions during a solar eclipse and the conditions normally experienced at sunset and sunrise, including the east-west motion of the eclipse terminator, the speed of the transition, and the continued visibility of the corona throughout the eclipse interval. Taken together these factors imply that unique ionospheric responses to the eclipse may be expected. We expect to find that the eclipse will produce unique changes in the ionosphere's electric fields and Total Electron Content. Flux tube integrated effects may also be significant in an eclipse. Balloon experiments or remote sensing may offer promising ionospheric observation techniques for the 2017 eclipse.

Mentor(s): Dr. Gregory Earle

2. Susannah G Darling

Graphical Tool Development for Nano-Satellite Mission Planning

This project is focused on discovering and visually depicting the effects that various altitudes, inclinations and masses have on the lifetime of CubeSat satellites. Cubesats are modular nano-satellites comprised of blocks that measure 10x10x10 cm; they are becoming increasingly popular in research missions due to their size and cost effectiveness. The goal of this research is to create a tool for planning future CubeSat missions. The end product will allow for quick estimates of how the altitude, inclination, and mass of a nano-satellite in a circular orbit control the duration of time that it remains aloft. In order to determine this lifetime, Analytical Graphic Inc.'s Systems Tool Kit is used to model the orbit, and the lifetime tool is implemented to calculate the resulting orbit lifetime. This is done using various parameters for atmospheric models, amplitudes, inclinations, masses and propagators. These were applied to a particular mission, and results suggest that altitudes of over 350 km are necessary for collecting adequate data over multiple seasons, as below this altitude, CubeSats decay within a few months. Future missions will be able to use this research for improved estimation of the likelihood for achieving desired mission goals.

Mentor(s): Dr. Gregory Earle

3. Sean J Babcock

Studying the Effects of the Ionosphere's Electron Density on GPS Signals

In today's world, there is no question of the importance that a quality GPS system has on our everyday lives. As more advanced GPS applications are developed, the demand for superior GPS solutions grows. Today's GPS receivers have an accuracy of within a few meters. Accuracy and dependability are related to the electron density in the ionosphere. The ionosphere is the region of upper atmosphere (85 – 600 km in altitude) that contains particles that have been ionized by solar radiation. Ionization in this region produces free electrons which influence the propagation of radiation, including GPS signals. This project is designed to study the electron density in the ionosphere using real time and simulated GPS data in an effort to better understand and therefore predict the total electron content (TEC) in the ionosphere. This is accomplished by means of studying and comparing three separate techniques that model the ionosphere's TEC in order to produce software that will determine the TEC based on information received from GPS satellites. Over time, this will ultimately be used to study the behavior of the ionosphere's TEC to better predict the GPS signals propagation delay in the effort to increase the accuracy of GPS position from meters to centimeters, or better.

Mentor(s): Dr. Wayne Scales

4. Daumier J Maldonado

Thermal and Structure Analysis of CubeSats

CubeSat's are small satellites for space research that are becoming increasingly. Analysis of such structures before construction can help to ensure mission success. The spacecraft structure is a critical element of the satellite on which to perform thermal and structural analysis. Thermal analysis is the use of techniques to determinate the deformation of a given design caused by the heat, energy and temperatures that surround it. Structural analysis is the study of how the structure and materials are affected by the inner and external loads it has to withstand in a specific orbit. The Optical Profiling of the Atmospheric Limb (OPAL) is a NSF CubeSat that will be placed in Low Earth Orbit (LEO); its design is being analyzed to learn how it can withstand a given lifetime in space. By combining thermal and structural analysis a simulation can be created to determine how OPAL will be affected by the pressure of space, solar winds, and space weather that it will encounter over its lifetime. The space simulation is created by the Thermal Desktop software and the loads are applied in Autodesk Inventor software. Results of this work will allow the structure to be optimized, providing assurance that it will endure the desired lifespan in LEO.

Mentor(s): Dr. Chad Fish

5. Anthony T Wolosik

Modifications and Improvements to an Ion Source for Validation of Spaceflight Instrumentation

A thorough understanding of the ionosphere is important in the development and understanding of global positioning and communication systems for both military and civilian applications. Improvement of ionospheric models leads to better predictions of radio wave propagation in communication systems and GPS. This research project details the fabrication and testing of multiple components used in an Ionospheric Simulator (IonSim) previously designed by Saurav Dhar. IonSim is an ion source that simulates ionospheric conditions inside a laboratory vacuum chamber, thereby enabling instruments and systems to be tested under more realistic operational conditions. By heating metal filaments, electrons are emitted inside of the ion source. The electrons then collide with the neutral gas inside the source to create ions, which are subsequently emitted into vacuum due to electric potential gradients maintained inside the source. Once the ion source sufficiently provides an ion beam with comparable energy and current to low Earth orbit (LEO), this device will be used to perform end-to-end tests on the retarding potential analyzer (RPA) instrument designed for the Lower Atmosphere/Ionosphere Coupling Experiment (LAICE) CubeSat.

Mentor(s): Dr. Greg Earle

6. Riley W St. Pierre

Determing Appropriate Launch Dates and Times to Study Nitric Oxide Using Stellar Occultation

The goal for this project is to launch and point a sounding rocket deep into the polar night and use stellar occultation to view levels of nitric oxide (NO) in the upper atmosphere. Nitric oxide is a byproduct of the auroras and therefore can only be studied during the Alaskan winters and preferably without the presence of the sun, which can break up and decrease the levels of NO. NO has been known to cause depletion of ozone, therefore knowing and understanding the levels of NO in the polar night can prove to be very significant. In order to study the NO, determining the right launch altitudes, launch dates and times, and star geometry is critical. Stars with the correct UV brightness were collected using the TD1 catalog and then sorted through using the software Stellarium and Cartes du Ciel to determine which one to point at. The star should have the correct UV brightness, be oriented near the horizon during the Alaskan night, and be in the northern direction. Using the software and other mathematical models, Algenib can be confirmed as the most appropriate star to point at for a launch date around January 21, 2016.

Mentor(s): Dr. Scott Bailey

7. Amanda D Friedrichs

Exploration of Aurora in AIM Satellite Data

The Cloud Imaging and Particle Size (CIPS) instrument aboard the Aeronomy of Ice in the Mesosphere (AIM) satellite studies polar mesospheric clouds by measuring the reflected sunlight (albedo) off of the clouds. The purpose of this research is to investigate whether the AIM satellite can be used to study auroral data in addition to polar mesospheric clouds. If there is no sunlight data in a CIPS image, then any noteworthy albedo detected is most likely caused by the aurora, a source of electromagnetic radiation in the upper atmosphere caused by the excitation of particles. In order to study these possible aurora, code was written to eliminate data caused by noise or gathered from low zenith angles. Graphs of max and total albedo data versus day provided an idea of which days would have auroral images. The images were then mapped and compiled into easily readable forms to aid in future analysis.

Mentor(s): Dr. Scott Bailey

8. Caroline M McElhenny

Comparison of Solar Flare Data from GOES-15 Satellite to SuperDARN Radar Data

Solar flares are a specific type of solar activity which occur when magnetic field lines in the Sun's atmosphere (the "photosphere") annihilate each other, causing a rapid brightening of Xrays and other forms of electromagnetic radiation. Previous research has demonstrated that solar flares severely perturb the Earth's charged upper atmosphere (the "ionosphere") and affect worldwide communication and navigation systems through sudden ionospheric disturbances (SIDs) and changes in total electron content (TEC), to name a few. In this study, we use the worldwide Super Dual Auroral Radar Network (SuperDARN) to examine the ionospheric impacts of solar flares as a characteristic dropout in the backscattered radar returns produced by enhanced ionospheric densities. The primary objective is to qualitatively and quantitatively study how solar flares of varying intensity (or "class") affect the Earth's ionosphere, in terms of duration and spatial extent. Data from the National Oceanic and Atmospheric Administration (NOAA) GOES15 satellite quantifying the strength, duration, and location of solar flares has been investigated and compared with the number of SuperDARN radar range gates experiencing backscatter dropouts. The anticipated outcome of the study is to determine which types of flares have lasting effects on the ionosphere and thus an impact on our technology.

Mentor(s): Dr. Joseph Baker

9. Joel A Buttars

Adaptive Hardware-In-The-Loop Testing of LAICE Cubesat

Cube satellites are a relatively low cost spacecraft and are usually designed and flown in only two to three years from start to launch. With limited development time, subsystems need to be developed in a parallel manner. By using a bottom-up approach, modular testing can be performed on the subsystems to ensure compliance with the overall system. The LAICE cubesat is no exception. With multiple science instruments to measure waves in situ in the thermosphere and remote measurements of waves in the mesosphere. Testing of sub-payloads for the LAICE CubeSat will be conducted using hardware-in-the-loop testing. LabVIEW simulations will be used to interface A Photometer, an RPA, and a neutral gas measurement sensor. LabVIEW applications will be programmed to test each of the board's' functions, and using a vacuum chamber equipment we will test and calibrate the sensor in a near-vacuum environment to simulate the expected space environment. In addition to the science sensors, Lithium-ion battery cells will be tested to ensure that they can maintain operability for the lifetime of the mission. A test board will run the batteries through a series of charge/discharge cycles to determine how the capacity degrades over time. This will provide insight on how the spacecraft power plan should be adjusted over time to accommodate the degrading batteries.

Mentor(s): Dr. Greg Earle

10. James P Clouse

An Analysis of how Small Solar Flares Affect the Total Extreme Ultraviolet Energy Emitted from the Sun

The purpose of this research project is to identify how much small solar flares, which are often ignored in tradition dealings with solar flares, contribute to the total extreme ultraviolet (EUV) radiation given off by the Sun. It is important to find out how much these often ignored flares contribute because EUV radiation drives upper atmospheric chemistry. By achieving a more complete understanding of how the total amount and variability of EUV energy striking the earth, it will be possible to make more accurate models and predictions about Chemistry in the upper atmosphere. This research uses data from the EUV SpectroPhotometer (ESP) subsystem of the Extreme ultraviolet Variability Experiment (EVE) instrument on the Solar Dynamic Observatory (SDO) Satellite collected from 2012-2014. Robust statistics were used to obtain an accurate measure of energy without these solar flares and then with the solar flares. Code has also been written to remove any inaccurate data cause by an issue with the instrument. The preliminary results of this research show that smaller solar flares can have a substantial effect on the total EUV energy observed with total energy differences of 6-10% over the average year.

Mentor(s): Dr. Scott Bailey

11. Evan J Terrell

Quantifying the Effectiveness of Helmets: The Influence of the Facemask on Head Impact Response

Evaluating and improving helmet design plays a crucial role in reducing the estimated 1.6 to 3.8 million sports-related concussions that occur in the United States each year. Despite widespread use of facemasks by football and hockey players, most helmet evaluation methods do not test helmets equipped with facemasks. The purpose of the present study was to determine the effect that attached facial protection has on the kinematic response of a helmeted dummy headform during a linear impact. Helmets were fit to a modified NOCSAE headform and were subjected to blows from a pneumatic impactor. Four helmet models were used in this study (2 football, 2 hockey), with each model being tested both with and without a facemask. Tests were conducted at 3 impact speeds (3 m/s, 6 m/s, 9 m/s) and 4 helmet impact locations (front, side, back, and top) for a total of 12 impact conditions. 3 trials were performed at each condition. For each helmet model and test condition, a two-sample t-test was used to compare the peak linear and angular accelerations of the helmet when equipped with and when lacking a facemask. The findings of this study present the first evidence that facemasks do not alter the structural properties of the helmet shell in a way that affects the impact response of the head. These results can be applied towards the modification of existing helmet test standards and the development of new test methodologies.

Mentor(s): Dr. Stefan Duma

12. John E Brady

Tomorrow's Helmets: Quantifying the Effectiveness of Slip-Plane Technology in Reducing Rotational Head Accelerations

Despite helmet testing standards only considering linear acceleration, recent literature suggests a more direct correlation between rotational acceleration and concussion risk. As a result, helmet manufacturers are designing helmets which they claim can reduce rotational head accelerations using a slip plane. The objective of this study was to quantify the reduction in rotational acceleration that such technologies can provide. By comparing slip plane helmets to matched control helmets, the Multi-directional Impact Protection System (MIPS) and Bauer's Suspend-Tech Liner, were tested to examine their efficiency in reducing angular head accelerations. Using a custom dual rail drop tower, fitted with a NOCSAE headform and Hybrid-III neck, six of eight helmets were subjected to four 60 inch drop tests at three different locations. The remaining two helmets were subjected to the same testing for twelve repetitions at each location, allowing for a total of 144 tests. The NOCSAE headform was instrumented with three linear accelerometers and three angular rate sensors used to measure the kinematics of the head during impact. Two-tailed t-tests at a 95% significance level were used to evaluate differences between various helmet technologies. While neither the MIPS nor Suspend-Tech helmets were able to significantly reduce rotational head accelerations, advancement of these helmet technologies may provide a greater reduction of concussion risk.

Mentor(s): Dr. Steven Rowson

13. Kevin A Joseph

Noninvasive Post-Crash Occupant Symptoms Testing and Biometric Monitoring for Emergency Response

Background: A study by the CDC found that risk of death decreases by 25% when a seriously injured patient is treated at a trauma center instead of a local hospital. An estimated 1.5 million people will get a traumatic brain injury (TBI) and 1.1 million will be treated and released from an emergency department. The CDC also reported that car crashes are the second leading cause of TBI and the leaders in TBI deaths. Aim: A system to continuously monitor vital signs and test for the level of consciousness. These vital signs could help the car , diagnose the occupant's condition in order to speed emergency medical response. Method/Results: A MATLAB program will use an occupant sensor in the seat cushion of many cars to determine heart rate, respiratory rate, and weight. The program will also test for an occupant's Glasgow Coma Scale (GSC) score by testing an occupant's eye, verbal, and motor responsiveness through an interactive computer program. Conclusion: The preliminary driver monitoring system shows promise for post-crash injury assessment.

Mentor(s): Dr. Kristofer D. Kusano

14. Afton N White, Mei Bandy

Design and Development of a Bevameter

Design and Fabrication of a Shear Test for a Bevameter The purpose of this research is to develop an instrument that can be used to measure the shear resistance of soil. In the field of terra-mechanics, it is important to analyze the interaction between tires and its contact with different types of terrain. A bevameter is an invaluable tool when measuring the mechanical properties of soil. These findings will enable intelligent decisions to be made when considering the selection, development, and design of off-road vehicles in the fields of agricultural engineering and extraterrestrial studies. For the shear test, a shear ring and attachment cup were modeled after a project done by the NASA Glenn Research Center. The ring is lowered into the soil and used in application with shear loading under various normal pressures. The applied torque is then graphed against the angular displacement of the ring under each normal pressure and parameters of the soil can be derived. The anticipated results promise to have a high correlation of multiple tests on any soil.

Mentor(s): Dr. Corina Sandu

15. Austin C Dexter

Quarter-Car Suspension Test Rig

This project pertains to creation of a system that is able to test a variety of vehicle suspensions, allowing for direct comparison. The completed development of the quarter-car suspension test rig will allow for the availability of a space-efficient and affordable system that can feasibly be used by small companies or individuals. The system is currently inoperable due to a lack of a mechanism to excite the tire, simulating travel over a road surface. Procurement and implementation of a linear actuator completes the structural aspect of the system and allows for further developmental progress to be made. A trade-off between required amount of actuator power and its speed needs considerable investigation, based on available products in the market. It should be noted that integration of sensors and electronics as well as a control system are the future steps of this project.

Mentor(s): Dr. Saied Taheri

16. Brent Cox, Ryan Knights

BASE Suspension Testing

The purpose of this study is to outfit the BASE suspension on a rented International semi-truck and trailer then gather data on how it performs compared to the stock suspension so that the effects can be modeled. BASE developed a suspension that changes the way air is routed into the air bags of tractor trailers. In a stock setup the airbags are controlled by a leveling valve which determines whether to add or dump air. Then air from the leveling valve is routed in series which creates unequal air pressure in each bag do to loss in the system. The BASE systems differs in that it uses two leveling valves one per side. From the valves the bags have equal tubing lengths from the valve to ensure that any loss in the system is similar. These changes are to help improve tire wear and overall performance of the vehicle on the road. To gather the data accelerometers, string/rotary potentiometers, pressure sensors, cameras, and a GPS was used in local testing has been done as well as track testing. The next step is to analyze the data to look for any improvements with the new suspension.

Mentor(s): Dr. Mehdi Ahmadian

17. Eric N Pierce, Michael Ng

Volkswagen Jetta Braking Test to Validate ABS Model

Title: Volkswagen Jetta Braking Test to Validate ABS Model The Center for Tire Research has developed a new tire model which has been implemented into a vehicle simulation model. In order to simulate anti-lock braking system (ABS) induced vehicle braking maneuvers, the simulation model has been augmented with an ABS control logic and software. To validate this simulation model against measured data, tests must be conducted on a test track. Anti-lock braking system tests will be performed from 65 kilometers per hour to rest on a 2000-2004 model year Volkswagen Jetta. To do so, a Racelogic VBOX III global positioning system data logger with a satellite tracking antenna will be placed in a VW Jetta that is accelerated up to 65 kilometers per hour before the brakes will be applied firmly until the vehicle stops. The brake trigger attached to the VBOX III will record braking distance and stopping time. Using an Arduino Uno board, Adafruit Data Logging Shield, and a MinIMU-9 v3, we created an accelerometer and gyroscope that measures and records vehicle acceleration, pitch, and yaw, allowing us to account for skewed data during the brake test. If performed correctly, the sensors will record data onto a compact flash card that can be viewed on a computer to provide accurate results that coincide with the CarSim simulation within experimental error.

Mentor(s): Dr. Saied Taheri

18. Kevin T Engleson

Design and Fabrication of a Portable Road Profiling System

The purpose of this research project is to design and develop a portable road profiling system equipped with high fidelity scanning lasers. Currently, laser systems are used to scan and monitor road surface conditions for maintenance needs. The development of a scanning system with higher resolution lasers means it is possible to scan road surfaces for several macro texture features and parameters. The system comprises seven scanning lasers, an inertial measurement unit (IMU), triggering rack, and batteries for supplied power. Signal processing must be developed to interpret the data. The processed data can be implemented into driving simulators which will allow the lab to work towards its final goal of developing driver intervention strategies based on road conditions and driver input.

Mentor(s): Dr. John Ferris

19. Robert L Stevens

Piezoelectric Based Energy Harvesting Towards a Smart Tire

The work herein introduces the concept of a self-sensing tire with an inherent powering mechanism. This "smart tire" idea consists of two main parts. The first part requires sensing, processing and communication units which gather and process the required information about the health of the tire. The second part is an energy harvester that supports the previous units. This work studies the different possibilities of energy harvesting in a tire using Macro-fiber composites (or MFCs). MFCs make use of the piezoelectric effect to convert vibrational energy of the tires into electrical energy. Tests that simulate the excitation of the tire are designed and the response of the MFC is measured. An electrical circuit is designed to cater the voltage and the current requirements of the energy harvester; further, the performance characteristics of the MFCs charging coin cell batteries will be studied.

Mentor(s): Dr. Pablo Tarazaga

20. Kayla P Sykes

Using Driver Eye Glance Behavior to Determine Safety Implications of Adaptive In-vehicle Stop Displays

Traditional static stop signs get covered by vegetation, knocked over, and are often missed by drivers. Adaptive in-vehicle signage can eliminate these issues by placing road signage inside the vehicle. However, in-vehicle devices that use visual stimuli can adversely affect the driver by taking their eyes off the road, causing them to overlook potential hazards. The motivation behind studying these in-vehicle display (IVD) systems is to determine if any unintended safety consequences are associated with their use. Forty-nine participants (24 Males, 25 Females) ages 18-25 and 50 years or older participated in a closed test-track study where they experienced a series of scenarios in which they were presented with varying traffic control symbols (stop and proceed with caution) on the IVD. VTTI-developed software (Hawkeye) was utilized to manually code for eye glance location. This data was then analyzed to answer the following research questions: 1) Does the total eyes off road time increase significantly with IVD vs. static stop signs? 2) Does the number of driving-related glances increase while the driver is using the IVD?

Mentor(s): Dr. Zachary Doerzaph

21. Annabel St. Louis

An Evaluation of the AMES Profiler with Ro-Line Laser Sensor for the Measurement of Pavement Profile

If during the last century industrial resources seemed limitless, this era consists of a world concerned with the inevitable extinction of its resources. Sustainability is now the norm, and the U.S. department of transportation is ever more challenged with the optimization of its resource allocation. Several national research projects are in progress to improve the pavement life cycle cost; however, there are still limited options for the assessment of the road roughness, an important indicator of the condition of the pavement. Simple static devices requiring a lot of part human activity, such as the rod and the level, are capable of measuring pavement profiles. However, inertial profilers are automated, make profile measurements at highway speeds, and reduce human errors. The purpose of this study is to verify the accuracy of an inertial profiler named the AMES profiler, by comparing it to a reference measurement device. Measurements were taken with the AMES profiler on a section of the Smart Road at the Virginia Tech Transportation Institute where the reference profile of the pavement is known. The results of the comparison of the data provided by the profiler do not meet the necessary correlation specified in the standards with the reference.

Mentor(s): Dr Gerardo Flintsch

22. Maya Mills

Mitochondria and a High Energy Diet

Type II diabetes (T2D) is a chronic disease characterized by high levels of glucose in the blood. It is due largely to the current lifestyle of over consumption and physical inactivity. The mitochondria, the primary metabolic platform and energy generator of the cell, show aberrant changes in subjects diagnosed with T2D. This is because T2D leads to an accumulation of nutrients in the blood. This surplus of nutrients hyperpolarizes the mitochondria leading to a chain of reactions that ultimately impair insulin action. This can then dysregulate the electron transport chain, further impairing the mitochondria. However, a properly restricted calorie intake or maintaining a physically active lifestyle can improve mitochondrial integrity and function against metabolic syndrome. Our goal is to integrate both molecular and behavioral studies in order to increase the effectiveness of early intervention of those at risk for diabetes. This can be achieved by treating the mice with a high energy diet and identify a class of biomarkers that will give an early indication of those at risk as well as improve our system of available molecular diagnosis.

Mentor(s): Dr. Cheng, Dr. Fabio Almeida

23. Annie Ickes

Trimethyl-N-oxide Analysis

There is interest in the potential association between elevated plasma levels of choline and its metabolites and increased risk of adverse cardiovascular events. Choline is an essential nutrient for the body; it serves as a precursor for acetylcholine and phosphotidylcholine, which is an abundant component of the phospholipids in cell membranes. Choline can be obtained in the diet from food such as eggs and meat. Betaine, a choline metabolite, is required for proper amino acid metabolism,. A positive association has been reported between cardiovascular disease (CVD, such as atherosclerosis) and plasma levels of trimethylamine-N-oxide (TMAO), a phosphatidylcholine metabolite produced by the commensal gut microbiota. TMAO may represent a useful biomarker that reflects the impacts of both diet and the gut microbiota on CVD risk. A secondary analysis of plasma samples from three humn clinical studies with CVD risk endpoints was performed. Pre- and post-intervention plasma samples from an overfeeding study (additional kcals), water weight loss study and VSL3 probiotic study were analyzed for choline, betaine, and TMAO using ultra performance liquid chromatography-mass spectrometry (UPLC/MS-MS). These compounds were quantified by the stable isotope method using authentic deuterated (d9) internal standards.

Mentor(s): Dr. Andrew Neilson, Dr. Monica Ponder

24. Justin T Resendes

Effect of high-fat diet induce metabolic endotoxemia on insulin stimulated mTOR activity

Introduction: Research has shown a correlation between obesity and a hyperactive inflammatory response that is both a condition of and a contributing factor to the disease. High fat diets and diet-induced obesity have been shown to induce increased plasma Lipopolysaccharide (LPS) concentrations, a ligand for the innate immune receptor Toll-Like Receptor 4 (TLR4). It has been hypothesized that this increase in LPS-TLR4 interaction may be the link between inflammation and obesity. The term metabolic endotoxemia has been used to describe this state of elevated plasma LPS. Studies have shown that LPS treatments affect insulin stimulated glucose metabolism, but little is known about its effect on insulin stimulated mammalian target of rapamycin (mTOR) activity. Since dysregulation of mTOR has been associated with many disease states; we set out to determine if LPS may play a role in this dysregulation. Hypothesis: mTOR activity will be increased with a high fat diet as well as post LPS and insulin treatments versus insulin treatments alone. Methods: Mice were fed either a high or low fat diet for 8 weeks. Body composition was measured and glucose and insulin tolerance tests were performed. At 4 hours post LPS injection and 30 minutes post insulin, mice were euthanized, and whole muscle homogenates were used to measure fatty acid oxidation. Liver and muscle tissue was collected to measure mRNA and protein levels of targets important to inflammation and mTOR signaling.

Mentor(s): Dr. Matt Hulver, Dr. Madlyn Frisard

25. Sea-On Lee, Sonika Singh

Development of mobile exergaming apps

Physical inactivity imperils adolescents for many chronic conditions, including obesity and diabetes in later years. Further, physical activity (PA) levels in youth tend to track into adulthood. To promote PA in adolescents, several research groups have focused on exergaming approaches which combine exercise and gaming. Three smartphone based exergames were tested for middle school children and showed initial feasibility and effectiveness. The purpose of this project was to develop attractive mobile games for adolescents and their families with smartphones. The project began with an improvement of graphic design and scoring systems on three games: Fish Out of Water, Color Hunt, and Space Rayders. These games were published to the Google Store and have been advertised through a variety of methods, including online forums, departmental listserv, and paper flyers. The number of downloads, frequency of play (session), and duration of play were recorded to determine the participants engagement. After three weeks of advertising, Google Analytics showed that Fish Out of Water was downloaded 26 times, Color Hunt 9 times, and Space Rayders 5 times, with the number of sessions, 102, 96, and 32 for each game respectively. Color Hunt had the longest duration of play, 1 minute per game, compared to Fish out of Water (33 seconds), and Space Rayders (16 seconds). The findings of this study will be used to investigate the effectiveness of mobile exergaming in promoting PA in adolescents.

Mentor(s): Dr. Paul Estabrooks, Dr. Scott McCrickard

26. James P Foley

Can Genetics Identify Risk Factors for Low Motivation?

Acetylation and deactylation of proteins controls their activity. For example, the deacetylation of the NHLH2 transcription factor in mice has been shown to increase activation of the monoamine oxidase A (MAO-A) promoter in the brain. Mice containing a targeted deletion of Nhlh2 show low motivation for exercise, and adult onset obesity. The goal of this research is to test the hypothesis that NHLH2 regulated human motivation, through pathways involving differential acetylation and MAO-A activation. We are using both basic laboratory analyses and database studies to test this hypothesis. In the laboratory, four different single nucleotide polymorphisms (SNP's) predicted to affect acetylation of NHLH2 are being created within plasmids, using in vitro mutagenesis, such that mutant NHLH2 can be assayed for acetylation in neuronal cell lines. To examine human MAO-A genotype, and linkage to motivation and/or obesity, the low activity 3-repeat variable nucleotide tandem repeat polymorphism (VNTR) is being compared to the high activity 4-repeat VNTR using data from the NICHD SECCYD longitudinal study that examined a wide range of relevant phenotypes in 675 children from 3 months of age through 15 years of age. Overall, the studies may identify new biological and genetic pathways linking exercise motivation and obesity.

Mentor(s):Dr. Debbie Good, Dr. Kirby Deater-Deckard

27. Catelyn E Hill

Validity and Reliability of a Beverage Intake Questionnaire (BEVQ) for Adolescents

Sugar-sweetened beverage (SSB) consumption contributes to weight gain and obesity development; the intake of other beverages may also impact health status. Our objective was to evaluate the validity and reliability of the BEVQ for assessing SSB and beverage intake in adolescents. Participants (n=43; 57% male; age 14+2 yrs; BMI=21+3 kg/m2) completed four laboratory sessions, which included providing demographic information, assessment of height/weight, and four 24-hour dietary recalls. At two sessions, participants completed the BEVQ. Reliability: SSB energy (kcal) was not different according to BEVQ1 and 2 (143+120 and 155+207 kcal, respectively; P=0.61), and responses at the two time points were significantly correlated (r= 0.650, P<0.001). SSB and water fl oz were not different across BEVQ administrations. Validity: In the 37 participants who completed all recalls, SSB energy was not different between the BEVQ1 and dietary recalls (135+118 and 132+112 kcal, respectively; P=0.83). SSB energy was correlated for BEVQ1 and dietary recall responses (r=0.646, P<0.001). Total beverage energy and fl oz were not different across BEVQ1 and dietary recalls (444+480 and 353+229 kcal, respectively; P=0.106; 58+34 and 55+25 fl oz, respectively; P=0.613). These preliminary findings suggest that the BEVQ is a valid and reliable tool for measuring beverage intake in adolescents.

Mentor(s): Dr. Brenda Davy, Dr. Tina Salva

28. Andrew Anklowitz

Effect of P21 Gene on Blood Vessel Growth

A certain pattern of blood vessel growth is observed in patients following traumatic brain injuries. This research is based around seeing how different genes affect the growth of blood vessel collaterals in the brain of mice following a traumatic head injury, specifically the P21 gene. We have engineered a gel that turns off certain genes that we can inject in the cavity left from the injury. We then record data from the brain like the number of collaterals on the side of the injury and the side opposite the injury. Results are expected to show that the genes that are being shut down will increase collateral growth, and will subsequently shorten recovery time. The goal is to have this research to assist in the recovery of humans that have suffered head injuries.

Mentor(s): Dr. Michelle Theus

29. Rebecca I Engler

Production of CNT-reinforced Steel through Induction Heating

This research aims to incorporate carbon nanotubes (CNTs) into a metal matrix of steel, thereby giving the steel increased mechanical properties and reduced weight.1 CNT-reinforced steel could potentially be used for building infrastructure and automobiles. The Damascus sabers forged by ancient metallurgists inspired this research. Analysis of these iron swords led researchers to conclude that they contained cementite nanowires, which resulted in increased strength without the brittleness typical of high-carbon steels.2 Later research proved that carbon nanotubes surrounded these cementite nanowires.3 The effects of low temperatures, high temperatures, cyclic heating, rapid quenching, and hot rolling have all been explored during this project. This summer, steel-CNT sandwiches were melted through induction heating at temperatures greater than 1425C. These experiments demonstrated how heating the steel above its curie temperature can affect its chemical and physical properties and whether or not CNTs can persist in a reactive molten metal environment. The samples will be analyzed with a Focused-ion Beam (FIB) and Scanning Electron Microscope (SEM) for evidence of CNT persistence. Evidence of CNTs permanently imbedded in the steel's metal matrix with uniform alignment and dispersal will indicate a potential pathway for incorporation of CNTs in the steel and the formation of aligned cementite structures.

Mentor(s): Dr. Barry Goodell

30. Parvathy P Ganesh

Studying the efficiency of drug delivery using Colon Cancer cells

In order to efficiently deliver drugs into organs, drugs must bypass the organ linings. This is difficult because cell linings are composed of cells sharing membranes in structures called tight junctions. Tight junctions function by creating cell barriers, disabling large materials, such as drug molecules passage into the tissue allowing diffusion and active transport. In this study, colon cancer cells (CaCo-2) will be used to mimic the organ lining tissue in order to investigate ways in which drug delivery can be made more efficient. Cytotoxicity tests were conducted with curdlan a drug delivery polysaccharide, and displayed no toxicity to CaCo-2 cells. As a result, more tests will be done using CaCo-2 cells to investigate whether curdlan can open tight junctions. Trans epithelial electric resistance (TEER) tests will be conducted on hydrophilic polytetrafluoroethylene membranes to determine if monolayers can be created. Once monolayers are created, a set of control studies using Mannitol and Insulin will be conducted. This will investigate whether the monolayer lining grown is able to mimic an organ allowing curdlan to open tight junctions and allow drugs through into the organ.

Mentor(s): Dr. Abby Whittington

31. Robyn A Goad

Effects of Solar Irradiation on Dissolved Organic Carbon Concentrations and Bioavailability

Dissolved organic carbon is an integral component of stream ecosystems; however, increased dissolved organic carbon concentrations can be detrimental to the overall health of the stream and can lead to increased carbon dioxide emissions from the ecosystem. Photochemical degradation by solar irradiation is thought to be an effective removal system of dissolved organic carbon. In this experiment, three local streams of varying uses (urban, agricultural, and forested) were tested to determine initial dissolved organic carbon concentrations and the effects that solar irradiation simulation had on those samples. To observe these effects, each site sample was divided in half. One half was left under a solar irradiation simulator for six hours while the other half was not irradiated. The dissolved organic carbon concentrations of all samples were measured, along with the absorbance at 254nm and the fluorescence index. The absorbance and fluorescence values were used to calculate the specific ultraviolet absorbance of each sample, which relates to the bioavailability of the carbon. It is important to determine the bioavailability of the remaining dissolved organic carbon post-irradiation to understand how these changing carbon concentrations may affect microbial populations and other stream processes.

Mentor(s): Dr. Durelle Scott

32. Jonathon G Howarth

Monitoring Lesion Size During IRE Treatment Using Electrical Impedance Spectroscopy

Irreversible electroporation (IRE) is a new technology used to ablate tumors by delivering a series of pulsed electric fields (PEFs) to compromise the integrity of the plasma membrane of the cells. Simulation of the electric field distribution within the tissue can give a rough estimate of the geometry of the ablated tissue, however due to tissue inhomogeneity the simulated result may vary from the treatment outcome. Finding the lesion size during electroporation and tuning the electric field for optimizing the lesion size is an important factor during IRE treatment. Electrical impedance spectroscopy (EIS) is an important tool to monitor the behavior of live tissues. This study aims to reveal the effects of IRE on the electrical impedance spectrum of the treated tissue and use its impedance signature to map the margins of the ablated area. As the first step we used potatoes as the platform for running the experiment. We fabricated the proper impedance probes for mounting inside the potato. We applied a series of PEFs with different parameters such as number of pulses and field magnitude to different potatoes and obtained the impedance spectrum at different points in the ablated region. Our results show that the IRE treatment has a significant effect on the impedance spectrum of the tissue and proves that this method could be used for monitoring the extent of tissue ablation during the treatment. The outcome of this research would provide the physicians with the proper tool for a better treatment of tumors using IRE.

Mentor(s): Dr. Davalos

33. Kimberly R Hughes

The effect of fullerenes and carbon nanotubes on nitrifying bacteria in wastewater treatment plants

Engineered nanoparticles are in many everyday items that are washed down the drain and into wastewater treatment plants where they could potentially be harmful to the resident bacteria. This experiment introduces fullerenes and carbon nanotubes into lab-scale wastewater treatment plants in order to determine the effects these materials have on bacteria associated with nitrogen removal, in particular ammonia oxidizing bacteria and nitrite oxidizing bacteria. Eight lab-scale wastewater treatment plants were simulated using sequencing batch reactors and were dosed with different materials. Four were control reactors and the other four were dosed with nanoparticles. Data collected was used to identify whether or not reactor function failed as they were being dosed with the nanoparticles. Preliminary data indicate that the nanoparticles are not resulting in reactor failure, as indicated by low ammonia and nitrite levels and high concentrations of nitrate. If the reactors were failing, there would be a high level of ammonia in the reactor effluent because bacteria would not be oxidizing ammonia. Reactor failure would also be indicated by a high level of nitrite in the ion chromatography results because the bacteria would be oxidizing ammonia to nitrite, but not completing nitrification, which is to oxidize nitrite to nitrate. Therefore, the reactors are functioning well, which suggests that fullerenes and carbon nanotubes are not inhibiting nitrifying bacteria.

Mentor(s): Dr. Amy Pruden

34. Ashkan Katirai

Water Sanitation in the Global Perspective

In spite of progress being made, access to clean water is a significant challenge in low resource settings. Unclean water can contain high levels of E. coli and other bacteria. This is a serious problem in developing countries where there is a prevalence of infectious diseases. Even if the water obtained meets the World Health Organization's (WHO's) water quality standard, it can still be contaminated while retrieving it from the water source, transporting it to the household, or storing the water in containers. Current solutions to purifying water include methods of filtration, chlorination, or boiling drinking water. But even after utilizing the water sanitation techniques, the water's E. coli level remains unknown. To determine the E. coli levels, we are developing a device that collects automated E. coli and coliform counts using a mColiBlue24 membrane filtration system. To test the device's validity and reliability, we used water samples from the duck pond on Virginia Tech's. In the future, we will use this device on site in Malawi. To ensure project success, we have also created sets of posters targeting different age groups for the people in Malawi, educating them on hygiene and water sanitation. By combining educational efforts with our devices, we plan to eliminate the water sanitation gap across countries and make purified water the new global norm.

Mentor(s): Dr. Lissett R. Bickford

35. Rachel C Ladenburger

Investigation of keratin nanomaterial structures and their application in cell inflammatory response

Human hair-derived keratins have been used in a variety of biomedical applications such as scaffold-design, controlled drug delivery, and tissue regeneration. Recently, keratin coatings have been used to augment macrophage differentiation toward an anti-inflammatory, M2 phenotype, which is associated with enhanced wound healing and tissue repair. The combination of structural characteristics, cellular activity, and ability to modulate the immune response may give keratins a unique advantage among biomaterials. To better understand the potential applications of keratin biomaterials, it is important to further investigate these physical, chemical, and biological attributes by probing network structure formation, the role keratins play in cellular and molecular pathways, and their influence on the transformation of monocytes to M2 macrophages. In this project, the structure of keratin nanomaterials was analyzed using dynamic light scattering (DLS) and scanning electron microscopy (SEM). Solubilized keratins were scanned using DLS at different temperatures, buffer solutions, and times to assess solution behavior. SEM was used to compare human-derived and wool-derived keratin networks. To investigate cellular activity, human hair-derived keratins were solubilized in culture medium to assess their influence on human monocyte cell differentiation. After monocyte-to-macrophage conversion, cells were stained for M1 and M2 macrophage markers and quantified using flow cytometry.

Mentor(s): Dr. Mark Van Dyke

36. Lily R Lewis

Increasing the Length of Large Amyloid Fibers

Large amyloid fibers have been shown to self-assemble spontaneously from different protein mixtures, such as the peptides produced from trypsin hydrolyzed wheat gluten. The goal of this project is to lengthen these fibers so they are more amenable to commercial uses and simple mechanical testing. The fibers are unique in that they have a high modulus because of their β-sheets, much like silk. Lengthening amyloid fibers requires understanding of a subtle kinetic process. Too high of a protein concentration results in fast aggregation to globules while the optimal concentration results in fibers that can lengthen on the correct time scale. Fibers have been grown in protein concentrations between 25 mg/mL and 0.01 mg/mL for up to 20 days. Periodically, a portion of the protein solution is poured and dried and fibers are manually extracted and measured. Fibers grow slightly in length with time at any concentration. Preliminary results indicate that 0.01-0.1mg/ml is the optimal protein concentration to maximize large amyloid fiber length.

Mentor(s): Dr. Justin Barone

37. Thuy A Nguyen

Prostate Cancer Outcome Research

Cancer treatment research is a growing field in which researchers and doctors are endlessly trying improve methods. Cancer severity can range depending on where it is located in the body and in the case of prostate cancer, it is possible that with current technology, patients might not need hormonal treatments, radiation, or surgical intervention. In this research project, articles on prostate cancer were surveyed in order to understand how to measure and compare treatment outcomes. Each type of intervention used to treat prostate cancer can trigger different side effects, thus making it hard to determine which intervention would be best. It is necessary to find the treatment that would most optimize the patient's lifestyle. Eliminating harmful factors that are included in an intervention and finding the intervention that will most optimize a patient's lifestyle is the final goal of this project.

Mentor(s): Dr. Seong Ki Mun

38. Jay J Pandya

EEG Spectral Analysis of Alzheimer's Networks during Priming

Our understanding of the intricate changes that evolve in highly interconnected neuronal pathways during aging and disease processes in the human brain can be enhanced by human functional neuroimaging. In particular, neuronal oscillations are thought to underpin local and long range communication in the brain. In present electroencephalography (EEG) studies, several sophisticated computational approaches have related subtle fluctuations in EEG synchrony and oscillations as a possible observable effect of Alzheimer's disease (AD) on EEG. By applying a time-frequency analysis of ongoing brain activity during an implicit memory task, we anticipate an alteration of EEG rhythmic activity frequency bands, in patients compared to controls, particularly in induced gamma band responses (GBRs). We analyze two datasets per cohort – where they indicate whether the pictures shown are novel or repeated. By measuring the implicit memory of these subjects, we intend to compare oscillations in the temporal prefrontal neuronal network of AD patients with normal age-matched controls and characterize concomitant cognitive impairments associated with AD. We expect to extend upon the results of Gruber and Muller (Cerebral Cortex, 2005) and find that repeated exposure of the same picture will either enhance or depress the intensity of GBRs in different magnitudes in AD patients compared to controls.

Mentor(s): Dr. Rosalyn Moran

39. Seonghoon Park

Silver Nanoparticle Dissolution Rate

Silver nanoparticles (AgNPs) are becoming more readily available for people to use in their everyday lives. Silver, in its nanoparticle form, has beneficial properties that help to kill bacteria. The ability of AgNPs to efficiently kill bacteria is a primary reason why it is utilized in hospitals to sanitize equipment and eliminate odor from clothing. However, there exist environmental concerns once it enters the wastewater treatment and natural water systems. AgNP have been found to be harmful to many invertebrates and fish. This study demonstrates how the different sizes of AgNPs dissolve at different rates in water. We measured the dissolution rate of four different diameters of annealed silver: 800, 300, 50, and 20 nm. Atomic force microscopy was used to measure the heights of the AgNPs and based upon those heights, we were able to determine how fast the AgNPs dissolved. Ag800 and Ag300 dissolved very slowly while Ag50 and Ag20 dissolved quickly. Ag50 and Ag20 did not completely dissolve indicating that there are several extra factors that prevent AgNPs from dissolving completely..

Mentor(s): Dr. Peter J. Vikesland

40. Matthew Razaire

Corrosion of Private Plumbing System Components under Varying Water Chemistries

The presence of waterborne contaminants of potential human health concern in private water systems is an increasingly recognized public health issue in the United States. Private water system treatment and maintenance is not regulated, and they are susceptible to aggressive water conditions. Aggressive, or corrosive, water can damage plumbing materials, releasing metallic substances, such as lead, into drinking water. This study evaluated the corrosion of plumbing materials typically found in private systems in Virginia. To evaluate this issue, plumbing components (i.e. brass pipes and fittings) were exposed to varying water conditions of pH (acidity) and alkalinity (acid buffer) using a dump-and-fill method similar to that used by the National Sanitation Foundation (NSF) in certification tests. Daily water samples were analyzed for presence of metallic contaminants via Inductively Coupled Plasma – Mass Spectrometry (ICP-MS). Results indicate that corrosion and contamination was highest at the lowest pH values (most acidic). Additional study is needed to evaluate other plumbing components (e.g. pumps, etc) to more fully understand sources of lead and potential patterns of release, as well as lead release under other water chemistries found in Virginia drinking water.

Mentor(s): Dr. Leigh-Anne Krometis

41. Andrew Restaino

Characterization and Analysis of Polymer Contrast Agent Catheter Mimics for Near Infrared Imaging

Peripherally inserted central catheters (PICCs) are hollow polymeric tubes that transport nutrients, blood and medications to neonates. To determine proper PICC placement, frequent x-ray imaging of neonates is performed. Because x-rays cause severe health risks to neonates, safer alternatives are needed. We hypothesize that near infrared (NIR) polymer composites can be fabricated into catheters by incorporating a fluorescent dye and visualized using safer alternatives to x-ray imaging. To fabricate catheters, polymer and dye are dry mixed and pressed, sectioned, and extruded to produce hollow tubes. In order to be used clinically, material properties of the composite catheters must match the medical grade equivalent. We analyzed surface roughness, dye retention, stiffness, and near-infrared contrast intensity. There is no statistical difference in roughness between polymer composites compared to hospital grade hollow tubes. Over a period of twenty-two days, 70% of the dye was retained in the polymer composite tube. The stiffness of the composite tube and medical grade catheter tubes are comparable. The addition of 0.025 wt% fluorescent dye resulted in a 14-fold contrast enhancement. Catheter mimics could be imaged up to 4 cm under tissue equivalent. We successfully proved that catheters can be imaged without the use of harmful radiation and still maintain the same mechanical properties as the medical grade equivalent.

Mentor(s): Dr. Bickford

42. Tony Rizk

Cell Growth and Adhesion on Polymer Surfaces

This research focuses on quantifying the compatibility of fibroblasts for various UV-cured polymer surfaces using two distinct methods. First, by applying a constant shear force using a spinning disc apparatus, the affinity of cells for a polymer surface may be quantified; secondly, the affinity of a polymer surface can be determined by assessing the viability of cells grown on the polymer surface. The purpose of the study is to develop novel, 3D-printed polymer scaffolds for tissue engineering that could eventually lead to producing highly efficient drug delivery systems. In order to determine the influence of shear rate on cell adhesion, COS7 fibroblasts are allowed 1 hour to grow on a given polymer surface after which they are spun for 10 minutes at a set torque, and the number of remaining cells is ascertained by fluorescence microscopy. Finally, the growth of cells is determined by plating a constant number of cells in 96-well plates and determining the number of viable cells by counting or quantitatively using the luminescence Cell-titer Glo Assay.

Mentor(s): Dr. Timothy Long

43. Kent A Robinson

Help Streams, Help Themselves

This project entails a detailed study of the varying complexity of first order streams, and the correlating effects that that complexity has on the Hyporheic zone. This is analyzed by means of various salt and tracer injections in order to view the characteristics of an undisturbed stream. After this data has been gathered, structures were built into the stream to adjust the complexity by increments, subsequent tracer tests were then run to view what changes in increased complexity has on the overall nature of the stream. This was accomplished by use of Resazurin, a "smart tracer" that also acts as a fluorescent. This tracer changes into the daughter compound Resorufin when it interacts with microbial activity. The combination of this tracer as well as Nitrate samples allows for detailed measurements and data points to be collected. This data was gathered by means of filtered samples at three separate locations across the stream during the test, as well as temporal samples to allow for "snap shots" of the streams activity at a given time. After approximately 20 structures have been created over the 200 meter stream, the experiment will conclude after maximum stream complexity has been reached.

Mentor(s): Dr. Durelle Scott

44. Christopher A Rubel

Creating a bacterial inverter for the purpose of expressing green fluorescent protein

The purpose of this research project was to build a genetic circuit that can be switched between two different protein outputs, more commonly known as an inverter. The genetic inverter is a fundamental tool of synthetic biology that can be used in conjunction with similar constructs (toggle switch, etc.) to create elaborate biological circuits and systems. The inverter consists of a Ptrc2 promoter coupled with a tetR gene, and a PL, tet0 promoter with a gene for green fluorescent protein (GFP). The genes' expressions are mutually exclusive as TetR binding to PL, tet0 prevents production of GFP. Within a LacI-producing bacterial cell, the Ptrc2 promoter will be repressed by the LacI protein, which will halt production of TetR and permit the cell to express GFP. Addition of Isopropyl β-D-1-thiogalactopyranoside (IPTG) will inhibit LacI activity and allow TetR to be produced, repressing the expression of GFP and inverting the output. Conversely, anhydrotetracycline (aTc) functions as an activator for PL, tet0 and promotes GFP expression. The pFYS004c plasmid was built using several genetic cloning techniques. Steps included isolation of bacterial DNA, DNA cutting using restriction enzymes, DNA ligation, gel electrophoresis, and transformation of DNA into chemically competent cells. Ultimately, the construction of the pFYS004c plasmid was concluded to be successful, as tests displayed the expected levels of growth and fluorescence after IPTG and aTc were added, and the gel electrophoreses rendered DNA fragments of appropriate lengths. The cells, however, displayed levels of fluorescence that were lower than expected when no chemicals were added, but since addition of aTc increased fluorescence, we proved GFP production was functional. It was hypothesized that the cells themselves did not produce as much LacI as initially thought, resulting in lower initial fluorescence. Future tests to test this hypothesis involve transformation of the inverter plasmid into a known LacI overproducer.

Mentor(s): Dr. Warren Ruder

45. Rachel Stein

Innovating Google Glass for a Surgical Environment

The potential of Google Glass has caught the eye of many surgeons around the world, as having a hands free smart device offers mobility and security. Our group is developing a surgical manual that outlines and diagrams certain complex surgeries, which are displayed through Google Glass. This surgical manual allows a surgeon to refer to pertinent information that may be overlooked or forgotten while performing the procedure. Our program for Google Glass offers mobility as it can be controlled through voice activation and security in the ability to retrieve information that will assist the accuracy of the procedure. We believe the surgical manual for Google Glass will also act as a great educational tool for residents performing surgeries, as they are novices in the field. The assessment of our surgical manual will be based on the effectiveness of voice navigation through the manual. The user will qualitatively analyze the ease of accessing information while performing the surgery and the validity of content and diagrams presented. Overall, we hope to generate an easy to navigate surgical manual for Google Glass that is user-friendly and efficiently aids a surgeon during a procedure.

Mentor(s): Dr. Alfred Wicks

46. Hannah Mae Tecson

Mobile Health Sensors

Mobile health commonly known as mHealth is the use of mobile technology (e.g., cellphones and one other example) for health and medical avocations. We evaluated the use of mHealth technology and sensors that address direct patient health problems. We focused on two health and medical issue categories: remote monitoring, and diagnostic and treatment support. mHealth sensors enable consistent monitoring of patients and easier diagnosis and treatment support thus allowing healthcare workers to focus on more severe patient health problems. We used reliable health and medical articles to evaluate how mHealth technology is used. We tracked a specific health issue, early detection of breast cancer, to assess the value of mHealth technology in that area. Patient privacy protection, costs of external sensors, reliable data, limited functionalities, and managing patient data are growing concerns. Those with the most to benefit from mHealth technologies, developing countries and the elderly, are not being targeted. While there are many mHealth devices in development stages and out in the market, only a few have proven to be reliable.

Mentor(s): Dr. Seong Ki Mun

47. Leejoo Wi

Sustainable nanotechnology: Recovery of gold from nanowaste by selective complexation using α-cyclodextrin

Today, with the increasing use of nanomaterials in consumer products, nanomedicine, diagnostics, environmental monitoring and pathogen detection, their disposal and waste management pose new challenges. Several nanotechnologies also employ resource-limited materials, e.g., precious metals (gold, platinum) as well as rare earth elements. It is therefore essential to develop strategies to recover and recycle these elements from nanowaste, and thus make nanotechnology more sustainable. However, at present, there are no federal or state regulations regarding nanowaste management or precious metal recovery from nanowaste. To address this issue, we are developing environmentally friendly, laboratory-scale methods to recover gold from liquid nanowaste. For our initial experiments, we used potassium tetrabromoaurate and citrate-coated gold nanoparticles as 'simulated' gold nanowaste. α-cyclodextrin was used to selectively precipitate gold via complexation. We then isolated gold by reduction using sodium metabisulfite. Currently, we are optimizing the gold recovery method, and in the near future, we will recycle the gold to make new nanoparticles. Besides developing new methods for recovering gold from nanowaste, our research also has the potential to inform future nanowaste management policies and further improve the current waste management practices in universities and research laboratories.

Mentor(s): Dr. Peter Vikesland

48. Caitlin A Wilkinson

Determination of antibiotic resistance genes in the Cache la Poudre River using quantitative polymerase chain reaction

Antibiotic resistance genes (ARGs) have recently been identified as an emerging environmental contaminant. With the increased incidence of antibiotic resistant bacterial infections among humans, there is interest in ways to limit spread of ARGs through the environment. The recent historic flooding event in the Cache la Poudre River of northern Colorado, which is characterized by a gradient of pristine and anthropogenic influence, provides an opportunity to better understand the mechanisms by which ARGs spread in the environment. Of particular interest is the ability of river sediment to act as a reservoir and vector for transport of ARGs. Specifically, this study examined extracellular DNA (eDNA) as a potential pathway for the spread of ARGs. Water and sediment samples were collected at representative sites along the river at various times before and after the flood. Several ARGs were quantified using quantitative polymerase chain reaction (qPCR) and a new propidium monoazide (PMA) qPCR method was developed to distinguish ARGs in live versus dead cells, with an additional DNA extraction step to distinguish eDNA specifically. Preliminary results indicate an association between anthropogenic landscape features and the presence of ARGs and that the flood may have altered the ARG distribution patterns.

Mentor(s): Dr. Amy Pruden

49. Madeline Edwards, Akira Horiguchi

Identification of Transcription Factor Programs under Methylation Control during Brain Development

Transcription factors (TFs) often bind to specific DNA sequences to promote or block gene expression. The interactions between TFs and target DNA sequences may be regulated by DNA methylation. Methylated DNA may inhibit some TFs access to their binding sites. It has been well recognized that DNA methylation plays an important role in neuronal differentiation, which is determined by a cascade of TFs. However, the epigenetic regulated TF programs critical to brain development remain largely unexplored. To fill in such a knowledge gap, we first analyzed mammalian brain methylomes to identify genomic loci differentially methylated during development. We then compiled a set of experimentally validated TF binding sites from TRANSFAC 7.0, JASPAR 2014, and UniPROBE databases and applied it to MEME Suite, ClusterZ, OrderZ, and the algorithm we developed to identify over-represented TF binding sites in differentially methylated sequences. Afterwards, we determined potentially significant TF interactions using TF binding site frequency and clustering. From our research, we have gained insight into the complexities of epigenetic regulatory networks underlying mammalian neuronal differentiation. We also learned how statistical algorithms can help us predict the interactions among TFs.

Mentor(s): Dr. David Hehuang Xie

50. Lily Hummer, Adam Mills

Developing Online Curriculum for Kid's Tech University

The goal of The Virtual Kids' Tech University is to improve science literacy in primary education to ensure a strong STEM workforce of tomorrow. The Virtual Kids' Tech University targets elementary and middle school students at a critical point in their education where they may be intimidated by science and introduces them to a variety of fields through interactive modules and lessons online. Throughout the past ten weeks, our group has been developing online science curriculum for the Kids' Tech University website. We have developed interactive modules that incorporate objectives from the Virginia Standards of Learning as well as aspects of Prof. Mather's NSF grant. These modules can be applied in a formal setting or in an informal setting, allowing flexibility for both teachers and students. The modules include lessons on cells, the scientific method, and queueing theory: application of the scientific method.

Mentor(s): Dr. Will Mather, Kristy Collins

51. Mark W Frazier

Characterization by Atomic Force Microscopy of Intermediate Amyloid Fiber Assembly Products

Amyloid proteins exist in nature in such diverse forms as barnacle cement, structural components of some fungal hyphae, and various insect and spider silks. These proteins self-assemble in solution under physiologic conditions to generate fibers of exceptional rigidity. Here, we use atomic force microscopy to examine intermediate assembly products of wheat gluten and related protein combinations. The dimensions of various structures and their rigidity as measured by determination of Young's modulus are described. These findings contribute to our understanding of the assembly of amyloid fibers and their potential application as renewable structural materials.

Mentor(s): Dr. Justin Barone

52: Melissa J Carr

Possible use of fiberoptic silica microneedles for clinical deep tissue body contouring: Ex vivo porcine skin experiments

Body contouring utilizing light and thermal radiation has been limited to near-surface skin and adipose tissue, which significantly reduces the efficacy of single cosmetic treatments. Utilization of fiber optic microneedles to deliver diffuse light pierce up to 3mm transdermally can liquefy a larger quantity of fat, thus allowing for less clinical visits and discomfort for the patient. Fat cells absorb near-infrared light of the 1210nm wavelength and liquefy easily, however, thermal imaging demonstrates local temperatures of 43°C and above cause carbonization or even necrosis of surrounding cells. Smaller, steeper-angle-cut tipped microneedles have been tested and found to reduce patient pain, have lower local temperatures along the needle shaft and tip, carbonize tissue less than larger needles, pierce skin more easily and thus penetrate to deeper tissue than topical treatments alone. Transdermal imaging experiments displayed the ideal set of conditions for most efficient liquification of adipose tissue in ex vivo pig skin.

Mentor(s): Dr. Jake Socha

Participating Programs

Fralin Life Science Institute Summer Undergraduate Research Fellowship (SURF)
Bioprocess Engineering for Sustainability NSF-REU
Cognitive Communications NSF REU
“Hands-On, Minds-On”: Multidisciplinary Approaches to Understanding and Preventing Societal Violence NSF REU
Interdisciplinary Water Sciences and Engineering NSF REU
Dynamics of Water and Societal Systems: An Interdisciplinary Research Program at the Virginia Tech StREAM Lab NSF REU
Space@VT NSF REU
A Multiscale Approach to Biomechanics NSF REU
Tire and Automotive Engineering (CenTire) NSF REU
Transportation Undergraduate Research Fellowship (TURF) Program
Bridging the gap between physics, computer science, and K-12 education (VBI)
Translational Obesity Undergraduate Research Scholars Program
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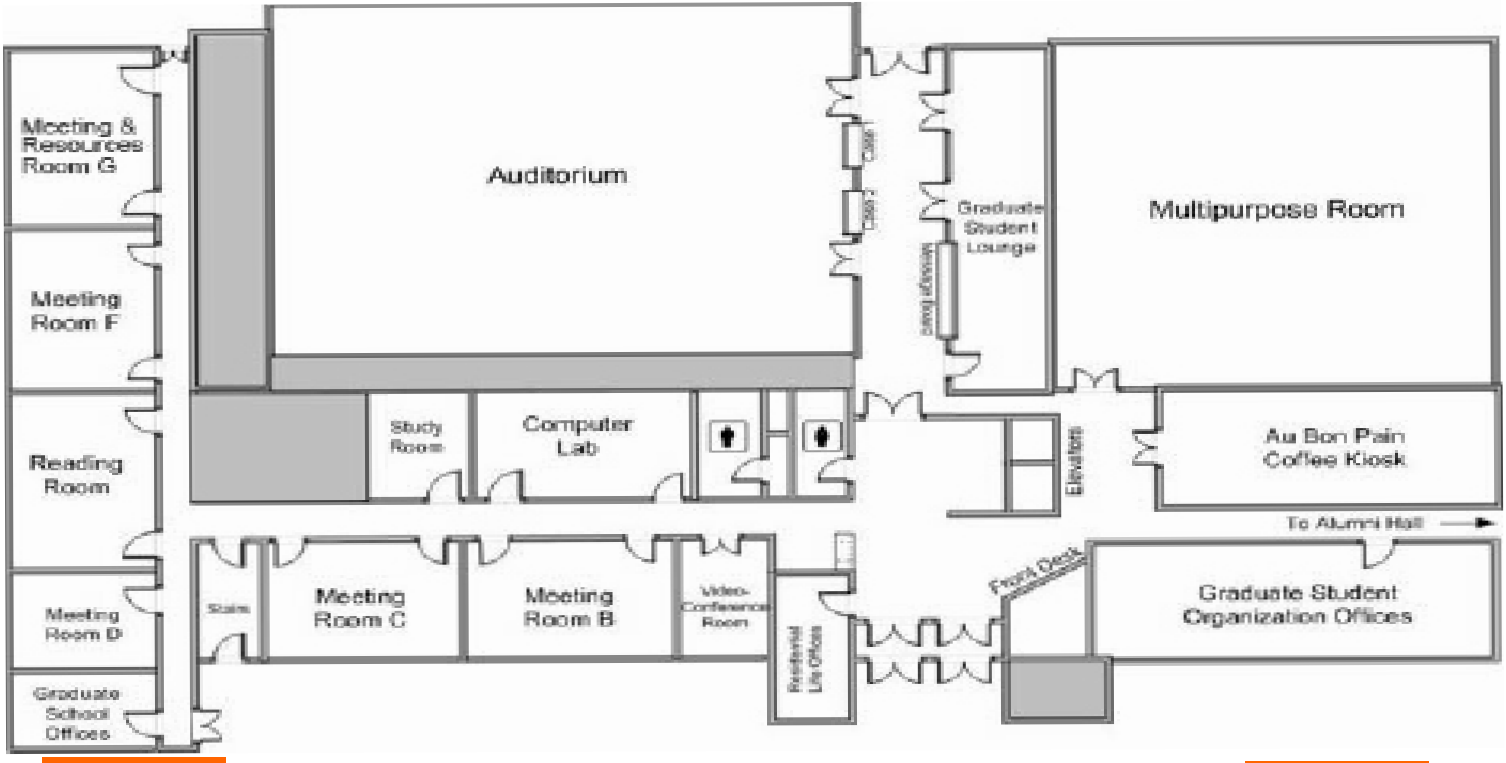

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