AUGUSTA UNIVERSITY
Center for Undergraduate
Research and Scholarship

10th Annual Symposium

July 16, 2020

4:00 PM

Summer Scholars Program

The Center for Undergraduate Research and Scholarship began to offer a summer intensive program in 2010. Over the past 10 years this program has evolved and grown, but the mission to provide students with intentional and intensive faculty mentorship in a scholarly project outside of the classroom has remained consistent. CURS Summer Scholars collaborate as junior researchers with their mentors, often times working in a research team, and receive professional development through weekly workshops. The program provides students a stipend allowing them to concentrate on accelerating and broadening their academic interests. By working directly with mentors on writing, data gathering, analysis and problems solving, students learn about a specific topic in depth while gaining new skills and polishing others that make them more prepared for graduate school or employment post college. Each collaborative team produces a scholarly product by the end of the summer that serves as a permeant achievement for the student and inspiration to future scholars. Over the years CURS has hosted dozens of mentors and over 300 student scholars working together to further student development and the research productivity of Augusta University.

Symposium Coordinators:

Ms. Aria Leathers, CURS Student Assistant

Ms. Melissa Knapp, CURS Coordinator

Dr. Quentin Davis, CURS Director

Order of Events

4:00pm **Welcome**
Dr. Quentin Davis, CURS Director

4:10pm **Opening Remarks**
Dr. Zach Kelehear,
Vice Provost for Instruction

4:15pm **Keynote Speaker**
Dr. Andy Hauger,
Professor, Department of Chemistry and Physics

4:30pm **Scholar Presentations**

5:20pm **Closing Remarks**
Dr. Quentin Davis

Presentation Schedule

	Inquiry	Discovery	Scholarship	Investigate	Innovate	Exploration
Moderator	Dr. Tugmon	Dr. McKinney	Dr. Gray	Ms. Johnson	Ms. Bateman	Dr. Miller
4:30 pm	Leslie Duncan Caleb Jensen	Adriana Hoell Iesha Williams Taryn Lykes	Antonio Gracy	Austin Newman	Madelaine Dubin Devin Johnson	Queen Tran
4:40 pm	Tim Kim	Taylor Hammerstein Makenzie Boyd Lyon Ngo	Keturah Stewart	Clarissa Thompson	Melinda McKew Shirley Zhang	Eyana Thomas
4:50 pm	Mili Patel	Jennifer Jones Sara Hillis	Jackson Stewart Sara Galvin Rachel Beal	Mehul Mehra	John Natale	Margaret Wade
5:00 pm	Ryan Frerichs	Madison Brown	Sydney Dains-McGahee Steven Nicosia Jocelyn Sloan	Rohan Kapuria May Ye Mon	Udochukwu Amanamba	Joselyn Amadiz-Bonilla

Program Mentors and Scholars

Dr. Clement Aubert, Department of Computer Sciences
  John Natale

Dr. Dustin Avent-Holt, Department of Social Sciences,
  Sydney Dains-McGahee, Steven Nicosia & Jocelyn Sloan

Dr. Manuela Bartoli, Department of Ophthalmology
  Udochukwu Amanamba

Dr. Hannah Bennett, *Department of* Kinesiology
  Adriana Hoell, Taryn Lykes & Iesha Williams

Dr. Jennifer Bradford, *Department of* Biological Sciences
  Ryan Frerichs

Dr. Darren Browning, Georgia Cancer Center
  Mili Patel

Dr. Zhou Gang, Georgia Cancer Center
  Tim Kim

Dr. John Hayes, Department of History, Anthropology, &
Philosophy
  Antonio Gracy & Keturah Stewart

Dr. Christina Heckman, Department of English and World
Languages
  Rachel Beal, Sara Galvin & Jackson Stewart

Dr. Maleah Holland, Department of Kinesiology
  Makenzie Boyd, Taylor Hammerstein & Lyon Ngo

Dr. Nai-Cheng Kuo, Department of Teaching and Learning
  Sara Hillis & Jennifer Jones

Dr. Rudolph Lucas, Department of Vascular Biology
      Mehul Mehra, Austin Newman & Clarissa Thompson

Dr. Lee Anna Maynard, Department of English and World Languages
      Madison Brown

Dr. Eric Numfor, Department of Mathematics
      Madelaine Dubin & Devin Johnson

Dr. Siva Panda, Department of Chemistry and Physics
      Eyana Thomas, Queen Tran & Margaret Wade

Dr. Surendra Rajpurohit, Georgia Cancer Center
      Rohan Kapuria & May Ye Mon

Dr. Yong Teng, Department of Oral Biology
      Leslie Duncan & Caleb Jensen

Dr. Almira Vazdarjanova, Department of Pharmacology and Toxicology
      Joselyn Amadiz-Bonilla

Dr. He Yang, Department of Mathematics
      Melinda McKew & Shirley Zhang

About our Speaker

Andy Hauger, PhD
Professor, Department of Chemistry and Physics
Augusta University

Dr. Andy Hauger is Fuller E. Callaway Professor of Physics in Augusta University's College of Science and Mathematics. He began his physics career in the late seventies as a high school student at Waukesha High School near Milwaukee, Wisconsin. After receiving his undergraduate degree in physics, he joined the military as a "Navy Nuke" and was lucky enough to spend four years on active duty teaching reactor physics in the nuclear Navy training pipeline.

After leaving the Navy, he attended Purdue University and earned his PhD in high energy nuclear physics in 1995. He began his career at Augusta University in 1996 and has taught physics and electronics here ever since.

He spent a year on leave at Vanderbilt University's Cancer Clinic where he was trained in radiation oncology physics. He returned to Augusta in 2006 as Chair of the Department of Chemistry & Physics − a position he held until 2010 when he became director of a new center on campus − the Center for Undergraduate Research and Scholarship!

Dr. Hauger enjoys the challenge of working in the electronics lab where he can often be found tinkering with Arduinos, Raspberry Pis and microcontrollers. His research involves electronic device development with collaborators from across campus and always involves undergraduates.

Although passionate about classroom and laboratory teaching, Dr. Hauger fully believes that some of the deepest forms of learning happen when students and faculty work together to create knowledge as members of a research team and so would like to congratulate this summer's student researchers and faculty mentors on a job well done!

Abstracts

Connecting Concurrent Computations

John Natale, and Dr. Clement Aubert
Department of Computer Sciences

Concurrent computations exploit networked computers to run program faster or collaboratively. By looking at it from a mathematical point of view, it becomes possible to abstract away the erroneous details that could cloud the view of the base structure. Multiple different mathematical structures have been proposed and exploited to represent concurrent computations; however, these different mathematical structures are not always as clearly compared to the others as one could wish. This lack of connectedness can be seen through the axioms in each paper that, albeit similar in appearance, they are intrinsically different and sometimes hard to relate. When multiple authors working with different definitions try to share their findings, they would have to start from the beginning when looking at the other person's work. In this presentation, I will discuss the model we have been studying, called labelled configuration structures, and some of its key aspects: comparison with other models, basics operations, and categorical interpretations. Through examples and carefully laid proofs, it is our hope that our effort will allow people working in the field to use a standard and clear definition. With this, the hope is that the study of concurrent computations will have an easier time developing and become more accessible as more people use and contribute to a unified definition.

What is Productivity?:
An Analysis of Economic Textbooks, 1890-1960

Sydney Dains-McGahee, Steven Nicosia, Jocelyn Sloan and Dr. Dustin Avent-Holt
Department of Social Sciences

Productivity is a fundamental concept in our modern understanding of economic activity. We value individuals, organizations, and societies that we see as more productive. But we rarely interrogate the underlying assumptions we make about what it means to be productive. In this project we analyze how economists have conceptualized productivity, and how this has changed over time. In particular, we focus on a critical period in the history of economics when at the turn of the 20th century modern economics emerged in what was known as the marginalist revolution. To understand how economists conceptualized productivity we analyzed economic textbooks from 1890 (roughly the beginning of the marginalist revolution) until 1960. We obtained a sample of introductory economic textbooks published between 1890 and 1960. The sample is restricted to only textbooks with more than one addition to indicate the text achieved at least some notable circulation during the period. This generated 42 textbooks, and we were able to find 27 of them already digitized. These 27 constituted our textbook sample. We analyzed these texts with a coding protocol designed to capture key dimensions of productivity. From our analyses we identified two core distinctions that economists made to demarcate the productive from the nonproductive, the first defining *what* counts as productive and the second defining *who* counts as productive. The first is the producer-nonproducer distinction, defining what counts as productive economic activity. This distinction evolved over time from defining producers as only those who produce material goods, to those who produce any utility (whether material or immaterial [e.g. a service]) deemed necessary, to those who produce utility for market exchange. A second distinction is the homogenous-graded labor distinction, defining who counts as being more or less productive. This distinction moves from treating labor as a whole as uniformly productive to distinguishing workers based on natural ability and then on education. The next steps are to figure out why these shifts occurred.

Blinding Crystals: Monosodium Urate and Diabetic Retinopathy

Udochukwu Amanamba and Dr. Manuela Bartoli
Department of Ophthalmology

Diabetic retinopathy (DR) is a common complication of diabetes and the leading cause of blindness among working-age adults. The incidence of diabetes is predicted to affect over 400 million people worldwide by year 2030. More than 60% of these individuals will develop some form of visual impairment within 15 years of disease onset and about 25% of them will become blind. Presently, there is no real cure of DR; therefore, preventing its progression represents major clinical goals. The identification and validation of new risk factors such as monosodium urate (MSU) will help to identify new diagnostic and therapeutic targets to ultimately prevent vison loss in diabetic patients. Hyperglycemia promotes chronic sub-clinical inflammation which in turn causes tissue injury and development of complications. Diabetic retinopathy results from inflammation of the microvasculature and the neuroretina. Previous findings suggest that increased levels of uric acid, a by-product of purine metabolism, contributes to inflammation in diabetes and the development of DR. A small increase of uric acid in the blood stream or in the retinal tissue beyond normal thresholds causes its precipitation as crystals of monosodium urate (MSU). MSU, being a pro-inflammatory factor, activates the cell component of retinal micro vessels and stimulates them to produce inflammatory cytokines. This research project will therefore investigate the molecular basis of inflammation in DR, the role of MSU in stimulating inflammation in retinal blood vessels and how to halt this deleterious process. To do this, cellular and rodent models are used to model the effects of diabetes in retinal micro vessels and a number of molecular techniques such as tissue culture, RNA and protein assays are employed to study the effects of MSU on the integrity and function of retinal blood vessels. The ultimate goal is to validate the use of uric acid-blocking drugs to prevent DR.

The CrossFit Community:
Does Inclusion Really Mean Everyone?

Adriana Hoell, Taryn Lykes, Iesha Williams and
Dr. Hannah Bennett
Department of Kinesiology

The CrossFit community is meant to be a community of inclusivity. This inclusivity is reflected in many domains: ethnicity, age, athletic experience, educational level, etc. One domain where this has potentially been seen as questionable is within the lesbian, gay, bisexual, transgender, queer (LGBTQ+) community of exercisers. While the former CEO of CrossFit, Greg Glassman, was extremely vocal in his acceptance and appreciation of these exercisers, there have been events in the past few years that have questioned the affiliates' (gyms who pay for the CrossFit name) acceptance of these individuals within their own gym. Furthermore, as the study progressed, the CrossFit community experienced events that called into question the perceived inclusion of other marginalized communities, such as Black, Indigenous, and People of Color (BIPOC).

This project was initially meant to examine the acceptance of LGBTQ+ exercisers within CrossFit to answer the question: does inclusive community mean everyone? However, given the sociocultural events that occurred during data collection, a secondary focus was then placed on perceptions of inclusivity with BIPOC CrossFitters. The Sense of Belonging Instrument-Psychological (SOBI-P) (Haggerty & Patusky, 1995) was implemented using a purposeful and convenient sampling. Data analysis and results were preliminary, as the survey population represented less than 2% of the global CrossFit gym population. A larger sampling is required for more accurate understanding of members' values, worth, and recognition within their CrossFit gym.

Determining the Effect of Microglial NF-κB deletion on Glioblastoma

Ryan Frerichs and Dr. Jennifer Bradford
Department of Biological Sciences

Glioblastoma (GBM) is the most common form of brain cancer in adults, and is often fatal within one year of diagnosis, even with treatment. The tumor microenvironment in GBM is thought to be one of the main contributors to its resistance to treatment. The tumor microenvironment is composed of a high percentage of resident microglia as well as macrophages which migrate from the periphery. Signaling between GBM cells and microglia via the NF-κB signaling pathway can alter the phenotype of the microglia, changing them from phagocytic cells (M1) to tumor promoting cells (M2). Microglia in the M2 state help the GBM grow and spread instead of destroying the tumor. Deleting the NF-κB pathway could prevent the microglia from changing phenotype and make the tumor less resistant to treatment. The Bradford lab created a conditional p65 knockout mouse model by crossing p65$^{fl/fl}$ mice with CX3CR1$^{creER/+}$ mice. The p65$^{fl/fl}$/CX3CR1$^{creER/+}$ mice have p65 deleted when they are given tamoxifen. This essentially deletes the NF-κB pathway because p65 is a transcription factor needed for the pathway to function. Currently, the model is being tested to ensure that p65 is being deleted appropriately. This has proven difficult as NF-κB levels in non-diseased brain are normally extremely low. To confirm the model is working, mice are being implanted with GBM tumor cells, which should raise p65 levels in microglia, but not in the knockout mice if tamoxifen has been administered.

Novel Phosphodiesterase 5 Inhibitors for Colon Cancer Prevention

Mili Patel and Dr. Darren Browning
Georgia Cancer Center

Colorectal cancer is one of the most commonly diagnosed cancers and accounts for 50,000 deaths in the United States each year. Preventing colon cancer therefore is a priority for patients at high risk of developing this disease. There are currently no drugs approved, but in recent years, a growing body of preclinical evidence supports the repurposing of phosphodiesterase-5 inhibitors (PDE5i) for colon cancer prevention. More recently, retrospective epidemiological studies of large databases support the idea that these drugs can prevent colon cancer in people. A potential problem with current PDE5i is the numerous side effects associated with systemic delivery, which is delivery via the bloodstream. The present study aims to develop novel PDE5i that minimizes side effects by avoiding entry into the circulation. We synthesized two polar analogs of the prototypical PDE5i sildenafil by replacing a methyl group with malonic and boronic acid (Mal-sild and BOH-sild respectively). These two analogs were significantly less abundant in the plasma of mice following oral administration. This showcased that the analogs were not systemically delivered. Using a cell-based system in vitro, both sildenafil analogs were able to enter cells and retained pharmacological activity but required higher doses relative to the parent compound. The results demonstrate that the Mal-Sild and BOH-Sild are promising agents for chemoprevention of colon cancer. Future efforts will demonstrate gut-retention and bioactivity of these drugs in preclinical models of colon cancer.

Developing Oxidative Stress-Based Immunotherapy for Cancer

Tim Kim and Dr. Zhou Gang
Georgia Cancer Center

Cancer cells are known to have increased basal level of oxidative stress, characterized by increased amount of reactive oxygen species (ROS). It has been well-established that elevation of ROS promotes tumorigenesis and cancer progression. However, if ROS levels are too high, it can be harmful to cancer cells. To prevent cell death, cancer cells must maintain a delicate balance between ROS production and removal, a process known as redox homeostasis. Since cancer cells already have higher basal level of ROS, they are more sensitive than normal cells when exposed to pro-oxidant agents that disrupt the redox homeostasis. This vulnerability can be exploited for oxidative stress-based cancer therapies. Although current studies have discovered pro-oxidants that are able to increase oxidative stress in cancer cells, these therapies fall short in that they do not achieve the required selectivity and durability. The Zhou lab is interested in developing oxidative stress-based immunotherapies by combining pro-oxidants with adoptive T cell therapy (ACT). Recent findings within the lab suggest that higher oxidative levels in tumor cells correlates with ACT efficacy. By increasing oxidative stress levels with a pro-oxidant, tumor cells can be rendered more sensitive to T cell-based immunotherapy. It is hypothesized that the combination of pro-oxidants with ACT can lead to synergistic antitumor effect. Several non-steroid anti-inflammatory drugs (NSAIDs) have been observed to act as pro-oxidants to enhance the efficacy of ACT. This project plans to study the combinatorial therapies of NSAIDs and ACT to develop an oxidative stress-based immunotherapy for cancer treatment.

Civil Rights at the Local Level:
The Struggle in Schools and Politics

Antonio Gracy, Keturah Stewart, and Dr. John Hayes
Department of History, Anthropology, and Philosophy

In the dominant popular memory, the Civil Rights Movement spoke to the conscience of White Americans, reached a culmination in Martin Luther King's "I Have a Dream" speech, and ended racial segregation across the South. The historical reality was more complex and less celebratory. These two projects explore aspects of the Movement in the late 1960s/early 1970s, in our local context (Augusta-Richmond County). Antonio Gracy's research excavates the long struggle to implement the Supreme Court's landmark 1954 *Brown v Board of Education* decision in the Richmond County schools. The White school board was deeply committed to maintaining segregation. It was the work of local Black activists, beginning with a 1964 federal lawsuit and culminating in a major 1972 decision, that brought genuine system-wide desegregation. At the same time, though, increasing numbers of White parents were investing in private schools. Through an oral history with a Black woman who, as a girl, was the first Black student to attend Augusta's oldest private school (Episcopal Day School), Gracy sheds light on the White beliefs that undergirded segregation and the techniques with which Black parents challenged these beliefs. Moving from the schools to elective office, Keturah Stewart's research uncovers the courageous story of Mrs. Carrie Mays, the first Black woman—and, in fact, the first woman—elected to Augusta's City Council, in 1970. Stewart shows how Mays' firm grounding in the Black community emboldened her to run for office, and how, once in office, Mays was passionately committed to keeping concerns of Black citizens in front of the predominantly White Council. Mays challenged overt racism and complacent patriarchy, and her example inspired other Black women to run for office. Mays' story is a local example of how the 1965 Voting Rights Act opened doors for Black politics—of how its ending of disfranchisement marked the beginning of a steady rise of Black elected officials.

Entangled: Discovering Other Worlds with the Inklings

Rachel Beal, Sara Galvin, Jackson Stewart and
Dr. Christina Heckman
Department of English and World Languages

This project originally proposed a student-authored and -edited collection of creative nonfiction and artwork emphasizing fantasy literature, particularly that of the Inklings of Oxford. Although this project began in tandem with a study abroad trip to the United Kingdom, those plans quickly shifted due to the COVID-19 pandemic. During our discussions of fantasy literature and theory, we reflected on the conditions of quarantine and the needs of our potential readers. Consequently, we re-oriented our project and renamed our collection, now entitled *Time to Wonder: Fantasy and Creativity amidst Pandemic*. This multi-genre collection explores the creativity born out of the isolation of quarantine amid the coronavirus outbreak. The personal essays, stories, poems, and artwork incorporated in *Time to Wonder* explore the contributions of fantasy, imagination, and vision to the creative process.

Our primary research question was: in the storytelling of J.R.R. Tolkien and C.S. Lewis and in our own lives, how are people, places, things, and worlds "entangled"? Secondary research questions included a) What do we mean by entanglement? b) What entanglements occur in our own lives? and c) How can fantasy storytelling help us engage with those entanglements? Our team ultimately decided to focus on this final secondary question. For us and our contributors, fantasy storytelling has been crucial in easing the adjustment to the pandemic and the drastic shifts it has caused in our relationships, our lived environment, and the creative process itself. During the project period, our team

- completed background reading on fantasy, sharing our notes and responses
- collaboratively drafted a call for submissions and distributed it on social media
- drafted individual creative pieces for inclusion in the collection
- identified potential publishers
- drafted a query to send to publishers
- outlined a selection process for submissions
- outlined editorial parameters to deploy in the fall as we edit the collection

PTSD and Insomnia: Does Ketone Supplementation Help?

Makenzie Boyd, Taylor Hammerstein, Lyon Ngo and
Dr. Maleah Holland
Department of Kinesiology

Insomnia is a sleep disorder commonly characterized as a chronic symptom of PTSD. Ketone bodies may improve insomnia as they directly inhibit sympathetic nervous drive and thereby reduce anxiety. Therefore, the purpose of our study was to determine if 6-weeks of ketone salt supplementation alters insomnia in individuals diagnosed with PTSD.

A randomized, triple-blinded, placebo (PLA)-controlled design was used to examine the effects of chronic ketone salt (KS) consumption on insomnia and PTSD severity in adults diagnosed with PTSD. Twenty-one participants, ages 21-65 years old, diagnosed with PTSD started the study and 16 completed the study. Participants were familiarized and visited the laboratory twice for data collection. During familiarization, participants signed the informed consent document and completed a health history questionnaire. The first data collection visit included baseline questionnaires assessing insomnia (insomnia severity index) and PTSD (PCL-5) severity. The second data collection occurred 6-weeks later after consuming either PLA or KS twice daily and included the same two questionnaires. A nonparametric Wilcoxon rank sum test was performed to test whether changes in the insomnia severity index and in the PCL-5 between visits 1 and 2 were different between KS and PLA. Each participant's visit 1 score was subtracted from their visit 2 score for both the insomnia severity index and the PCL-5 and then tested for differences in these changes between KS and PLA.

Results for each of these comparisons using the difference in medians between KS and PLA along with the corresponding p-values include: (Change in Insomnia Severity Index: median KS – median PLA = 4; p-value=0.37), (Change in PCL-5: median KS – median PLA = 3.5; p-value=0.38).

Chronic KS supplementation did not alter the severity of insomnia or PTSD in a small sample size of individuals diagnosed with PTSD according to two questionnaires.

A Qualitative Analysis of Individuals Who Overcome Their Dyslexia

Sara Hillis, Jennifer Jones and Dr. Nai-Cheng Kuo
Department of Teaching and Leading

Dyslexia is a neurological disorder that causes an individual to experience difficulty in reading. It exists around the world and affects about 20% of the population in the United States. In persons who have difficulty with reading skills, 70-80% of them are diagnosed with dyslexia according to the Dyslexia Center of Utah (2020). Yet, many still go through their early education either undiagnosed or not receiving the proper individual supports to be successful. In the present study, we conducted a qualitative analysis of 114 stories of people who overcame their struggles with dyslexia by analyzing individual interviews and videos via the website *Understood*.org. We synthesized the interviews by answering four questions designed to reveal their characteristics, their struggles in school or in their occupations, their turning points in life when they grasped how to use their dyslexia to succeed, and advice from their personal experiences to encourage others with dyslexia. There are many people with dyslexia who are highly accomplished in their own professional fields. Their experiences prove that people with learning and thinking differences have a unique view of learning and how they use their skills to adapt and achieve success. Learning from their stories will inspire students with dyslexia and help educators identify ways that are different from mainstream pedagogy to better support students. Implications for future research and educational services are discussed.

TIP Peptide as a Potential Therapeutic Treatment for Acute Kidney Injury in CoVID-19 Patients

Clarissa Thompson and Dr. Rudolph Lucas
Department of Vascular Biology

The kidney is an organ that filters waste, ions and molecules from the blood and maintains homeostasis in the body. Many patients hospitalized with CoVID-19 have acute kidney injury (AKI), a dysfunction of the kidney that prevents its ability to filter blood. To enter cells, the CoVID-19 spike protein, a protein on the outside of the virus, binds to angiotensin-converting enzyme 2 (ACE-2) which is an enzyme present in both kidney glomerular endothelial and epithelial cells. ACE-2 is important for suppressing the hyper-inflammatory response and regulates the epithelial sodium channel (ENaC), so when the CoVID-19 spike protein binds to ACE-2, it is no longer able to regulate its targets, which results in kidney cell injury and dysfunction. Furthermore, patients that have shown severe inflammation and collapse in their glomeruli were shown to overexpress a gene, called the apolipoprotein L1 gene (APOL-1), that is induced by RNA viruses such as SARS-CoV2 and which causes collapsing focal segmental glomerulosclerosis (cFSGS) and AKI. The drug, TIP peptide, a.k.a. Solnatide, was developed by the Lucas lab and was shown to restore glomerular endothelial and podocyte cell barrier and function, by directly activating ENaC channels. This poses the TIP peptide as a potential treatment for those suffering from AKI from CoVID-19 in murine models of glomerulonephritis. To test the TIP peptide as a treatment for AKI in CoVID-19 patients, mice with the human ACE2 (hACE2) and the human APOL-1 genes will be used in order to fully mimic the effects of CoVID-19 in the human kidney and evaluate the therapeutic effects of the TIP peptide in vivo.

A Novel ENaC-Based Therapeutic Approach to Blunt COVID-19-Associated Pulmonary Edema

Mehul Mehra and Dr. Rudolph Lucas
Department of Vascular Biology

Coronavirus disease of 2019 (COVID-19), induced upon SARS-CoV-2 infection, is a worldwide pandemic, with the majority of patients succumbing from viral Acute Respiratory Distress Syndrome (ARDS). In the normal lung, alveolar fluid clearance (AFC) is mediated through vectorial Na+ transport by epithelial sodium channels (ENaC). This keeps alveoli dry and maintains an effective gas exchange. After cleavage of its Spike (S) protein by proteases, SARS-CoV-2 enters alveolar epithelial cells through Angiotensin Converting Enzyme 2 (ACE-2). Subsequent immune response-mediated cytokine storm and direct actions of the S protein impair normal function of the alveolar epithelium and cause the buildup of edema. We propose that SARS-CoV-2's S protein will inhibit ENaC activity, on the one hand by means of hijacking furin, necessary for channel activation and on the other hand by reducing open probability in a PKC-dependent manner. Differential effects between the entire S protein, containing the furin cleavage site, and its receptor binding domain (RBD) on edema formation and AFC have yet to be investigated. To that purpose, we will use a humanized ACE-2 mouse model, in which we will instill S protein or RBD intratracheally and we will evaluate histopathology, inflammation, wet-to-dry lung weight ratio and capillary leak. Moreover, this approach seeks to determine the potential protective effect of a peptide directly activating ENaC -the TIP peptide- in hACE2 mice exposed to SARS-CoV-2 S protein or its RBD. TIP peptide treatment is expected to decrease the edema buildup and enhance AFC in both exposure groups, with a stronger pathology predicted in mice treated with complete S protein rather than solely the RBD.

A Novel Approach to Vascular Dysfunction in COVID-19

Austin Newman and Dr. Rudolph Lucas
Department of Vascular Biology

The beta coronavirus SARS-CoV-2 is the etiological agent of the COVID-19 pandemic. In about 5% of infected individuals, SARS-CoV-2 is responsible for devastating damage in the lungs and vasculature (arteries, capillaries, veins). This project focuses on studying mechanisms mediating the damage incurred by the endothelium, a thin layer of cells that lines all the vasculature. We want to gain knowledge on how viral encounter induces apoptosis and hypercoagulation, while impairing calcium transport and capillary endothelial barrier function (expression of the adherens junction protein VE-cadherin). We will evaluate the therapeutic potential of a peptide developed by the Lucas lab, called TIP peptide (a.k.a. Solnatide). The peptide is a mimic of TNF's lectin-like domain and has been shown to have beneficial effects on fluid regulation and endothelial barrier function in clinical trials in patients with acute respiratory distress syndrome (ARDS). This occurs upon activating Na^+ uptake by the Epithelial Sodium Channel (ENaC). The overall goal of this project is to investigate whether TIP peptide offers any benefit in protecting the endothelium from SARS-CoV-2 mediated damage. In order to mimic SARS-CoV2-associated vascular damage, we will use global humanized ACE-2 mice treated intravenously with either heat-inactivated virus or its Spike protein and we will apply TIP peptide 1 day after the insult.

Nancy Drew at 90: Violence, Competence, and the Young Female Protagonist in Literature for Children

Madison Brown, Dr. Lee Anna Maynard, and Melissa Johnson
Department of English and World Languages

The *Nancy Drew* mystery novel series, from its very beginning ninety years ago, has been deeply popular with young readers. A notable and primary feature of every *Nancy Drew* novel is the violence Nancy, the eponymous heroine, and other characters encounter. The project's research goals were 1) to document, catalogue, and classify the instances of violence in the first 25 *Nancy Drew* novels (most of which were written by Mildred Wirt Benson, under the pseudonym "Carolyn Keene," for the Stratemeyer Syndicate) in order to establish the prevalence of violence and 2) to begin to propose violence's function or functions within the book series. To this end, we analyzed the novels, developed classifications for different manifestations of violence, counted and charted them, and next began synthesizing that data to determine whether our hypothesis – that the violence at least in part provides credibility and *ethos* for Nancy, an amateur teenaged sleuth whose age and gender would often lead to her being dismissed and discounted – seemed to hold true. Our findings suggest that Nancy's relative imperviousness to serious injury or lasting psychological trauma in the face of countless violent assaults generates a sense of her extreme competence and credibility. Therefore, in the world of the novels and for the audience of her readers, she is able to show that she can handle herself in any situation and must and should be taken seriously.

A Mathematical Model of Pertussis with Vaccination

Madelaine Dubin, Devin Johnson, and Dr. Eric Numfor
Department of Mathematics

Pertussis (or whooping cough) is a highly contagious disease caused by the bacterium *Bordetella pertussis*, which attaches to the ciliated epithelial cells of the upper respiratory tract in humans. Pertussis is characterized and recognizable by fits of continuous coughing followed by a large inhalation of breath, which creates a "whoop" sound. The Centers for Disease Control and Prevention recommend vaccination as the best way to prevent pertussis infection in babies, children, teens, pregnant women, and adults. The current vaccines against pertussis in the United States are DTaP and Tdap, which provide protection against infection, but are subject to waning immunity.

 In this project, we formulated a mathematical model of pertussis with a two-dose vaccine in order to study the effect of vaccination on the dynamics of pertussis. We computed the control reproduction number of the model and derived both the disease-free and endemic equilibria. We proved that when the control reproduction number is below one, the disease-free equilibrium (DFE) is locally asymptotically stable, but when the control reproduction number is above one, the DFE is unstable, and an endemic equilibrium emerges. Furthermore, we established the local asymptotic stability of the endemic equilibrium when the control reproduction number is above one. In order to ascertain the relative effect of each parameter of the control reproduction number, we computed the sensitivity indices of the reproduction number with respect to each parameter. The recovery rate and the rates representing the different doses of the vaccine were most sensitive in reducing the control reproduction number of the model. Using different parameter regimes for recovery and vaccination, we carried out numerical simulations.

1, 3, 5 Triazine Derivatives as Potential Anticancer Agents

Eyana Thomas and Dr. Siva Panda
Department of Chemistry and Physics

Cancer is the second leading cause of death in the world. Despite current advancements, the mortality rate has not declined due to resistance to current therapeutics. There is a need for researchers to optimize the efficiency of therapeutics to combat this issue. 1,3,5 triazines or s-triazines entered the spotlight due to their versatile pharmacological properties such as antibacterial, antifungal, and anti-inflammatory activity. Recently, these triazines have shown promising anticancer activity. This has led to an influx of research to synthesize molecules using the 1,3,5 triazine moiety to act against different cancer cell lines. Substituted s- triazines allow for specificity to inhibit certain pathways in a cancer cell line. By reviewing the previous synthesis of triazine derivatives, certain substituents can be categorized by their specificity for a target. This information can be used to aid in the synthesis of new and more potent inhibitors.

We have compiled a database of molecules containing the 1, 3, 5 triazine moiety to evaluate the effect that adding substituents has on the antiproliferi at ve activity of the triazine nucleus against cancer cell lines. The diverse sets of 1, 3, 5 triazine derivatives that target a specific pathway and their ability to inhibit the target analyzed using computational software. The details of the studies will be discussed at the symposium.

Modified Curcumins as Potential Therapeutics for Breast Cancer

Queen Tran and Dr. Siva Panda
Department of Chemistry and Physics

Breast cancer is a prominent issue in the United States as well as the rest of the world, as 1 in 8 women are diagnosed in the U.S. and remains as the second-highest health fatality among women in the world. Several compounds derived from natural sources have been the topic of study regarding breast cancer treatment and aid. Curcumin, a compound found in turmeric of the rhizome *Curcumin longa*, has been a topic of research for several years, where studies highlight the anticancer properties of curcumin towards breast cancer and other cancers, in addition to anti-inflammatory and antibacterial properties. The FDA has declared curcumin as generally recognized as safe (GRAS); however, the compound exhibits low bioavailability, and studies cite its high metabolic rate as being one of the salient reasons. To combat this issue, studies have taken routes to modify curcumin as well as synthesize hybrid conjugates of curcumin and other anti-cancerous compounds, each of which targets a variety of genes, pathways, and proteins to result in apoptosis and termination of cell growth. In this study, previous literature references between 2015 and 2020 regarding curcumin analogs towards breast cancers have been explored and analyzed, followed by computational studies. We will discuss the details of the structural activity relationship during the symposium.

Ibuprofen Conjugates as Potential Anti-inflammatory Drug Candidates

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Inflammation is a common immune response to harmful pathogens and damaged cells. Non-steroidal anti-inflammatory drugs (NSAIDs) are commonly used to treat inflammation. These drugs work by inhibiting the cyclooxygenase enzyme systems (COX). The COX-1 enzyme system is responsible for releasing prostaglandins responsible for gastric mucosal integrity and proper renal function. The COX-2 predominates at sites of inflammation and releases prostaglandins that are responsible for vasodilation. A goal in the development of NSAIDs is to selectively inhibit the COX-2 pathway, as the adverse side effects, such as gastric lesions and perforation, result from the inhibition of the COX-1 pathway. The goal of this study is to review the previously reported works of literature of ibuprofen conjugates during the last five years. We have analyzed the effects of the conjugation on the biological activity of ibuprofen using computational tools. The details of the study will be discussed in the symposium.

Generation of Homozygous Casper (Transparent skin)-Transgenic Zebrafish Progeny to Study Microglia Function in Health and Disease Status

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Microglia are the resident macrophages of brain. which located along the central nervous system in the brain and spinal cord. The microglia cells act as macrophages, which support the immune system by cleaning any foreign debris. Zebrafish have become important models for scientific studies because of their affordable maintenance, transparent body plan during the embryo and larval stages, and genomic accessibility. We aim to use zebrafish as an organismal model to study how the microglial cells interact with glioblastoma. To achieve this, we are developing the *in-vivo* transparent transgenic zebrafish modeling system to study the microglia function and manipulation during the adverse condition such as inflammation as well as Glioblastoma. Glioblastoma is a vicious cancer of the brain that is extremely invasive. Our goal is to study the microglia mpeg:mCherry FP) with reference to inflammation (NF-kB:GFP) and cell death (Annexin- 5; YFP) process. The Microglia, NF-kB, and Annexin-V transgenic lines of the zebrafish help display which genes in the brain are being activated by the fluorescent protein. Furthermore, the mutant Casper line of zebrafish contributes to the study by integrating a transparent characteristic in adult zebrafish that allows for simpler visualization and observation in the final model. We have generated the individual strain of microglia, Annexin5, NFkB transgenic line and transparent mutant Casper fishes in our facility. By developing this transgenic phenotype, we will be able to develop this model to utilize microglia cells to address glioblastoma.

We are developing the novel Transparent skin Casper compound transgenic microglia strain of zebrafish to study the inflammatory process in health and disease condition. Furthermore, the newly strain will provide unique platform for high throughput drug screen to address the microglial based disease and injury with greater understanding and treatment of human disease and will be established as benchmark to study the microglia function and physiology in health and disease condition.

Comprehensive Analysis of FGF19-mediated Regulatory Networks in Head and Neck Squamous Cell Carcinoma

Leslie Duncan, Caleb Jensen and Dr. Yong Teng
Department of Oral Biology

FGF19 is a noncanonical fibroblast growth factor (FGF) ligand that can control a broad spectrum of physiological responses, which include bile acid homeostasis, liver metabolism and glucose uptake. Many of these responses are mediated by FGF19 binding to its FGFR4/β-klotho receptor complex and controlling activation of an array of intracellular signaling events. Our group and others have shown that upregulation of the FGF19/FGFR4 axis is strongly associated with tumorigenic formation, progression and metastasis in hepatocellular carcinoma and breast cancer cells. The 5-year survival rates for patients with head and neck squamous cell carcinoma (HNSCC) remain low due to lack of comprehensive and effective therapies established for this malignancy, emphasizing the urgent need for further identification of key regulators in HNSCC tumorigenesis and progression. Recently, we reported high FGF19 amplification in HNSCC, which correlates to increased autocrine secretion of FGF19 and poor patient outcome in HNSCC. However, the gene networks downstream of FGF19 are largely unknown. In this study, the HNSCC CAL33 cells were starved overnight, followed by the stimulation of human recombined FGF19 for 10 min. Total RNA extracted from FGF19-treated and non-treated cells was subjected to RNAseq to determine the differentially expressed genes in the presence or absence of FGF19 signaling. There are 174 genes upregulated and 57 genes downregulated in cells treated with FGF19 when compared with non-treatment. Gene ontology (GO) enrichment analysis of differentially expressed genes shows cellular process, cell part and binding are mostly affected by FGF19 based on the categories of biological process, cellular component and molecular function. KEGG pathway analysis further reveals the regulation of metabolism and p53 signaling among the most significantly regulated pathways. The study explores the FGF19-mediated regulatory networks, providing a strong rational basis for utilization of FGF19 inhibitors to better treat HNSCC in the clinic.

Does a Negative Emotional State Decrease Plasticity Related Gene Expression in the Hippocampus?

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Multiple psychiatric conditions, despite their specific characteristics, involve altered expression of immediate-early genes (IEGs). IEGs are genes that do not require new protein synthesis for transcription. For that reason, the transcription of these genes is faster compared to other genes, since they do not require the assistance of extra proteins that need to be synthesized prior to translation. This study focused on the immediate-early gene (IEG), specifically *Arc* and *Homer 1a,* in the CA1 and CA3 regions of the dorsal hippocampus of rodents. These specific IEG's encode for proteins that are synthesized at activated dendrites where they participate in consolidating long-term memory. The hippocampus is part of the temporal lobe memory system and is essential for the formation of episodic memories in rodents as well as in people. Previous work has shown that changing the emotional significance of a place affects encoding of memory in the hippocampus. It was shown that under stressful conditions such as foot shock, the hippocampus expresses less plasticity related markers, *Arc* and *Homer1a*. Here we seek to evaluate how a negative emotional state affects the encoding of emotionally neutral information in the hippocampus. If evidence is found to support the hypothesis, the information can be used to better understand the development of Post-Traumatic Stress Disorder (PTSD), caused by a traumatic event, and anxiety, which is triggered by stressful environments.

A Novel Computational Method Using Convolutional Neural Networks for the Prediction of Domain-Domain Interactions

Melinda McKew, Shirley Zhang and Dr. He Yang
Department of Mathematics

Protein-protein interactions (PPIs) are critical to proper functioning in cellular environments. Many laboratory techniques exist for establishing PPIs, but they are often resource-intensive and, as a whole, have resulted in an overwhelming amount of data. As such, researchers have turned to computational methods as an alternative and supplement to such laboratory techniques. These computational models rely upon machine learning in which programs are developed to make predictions or classifications from raw biological data, like protein structure, sequence, or function. Recently, a computational model using the physiochemical properties of domains, protein units that are evolutionarily conserved with similar functions across protein classes, to predict PPIs. More specifically, the model used predicted domain-domain interactions (DDIs) to identify PPIs. The purpose of the following research was to develop a similar DDI model using deep machine learning, specifically convolutional neural networks (CNNs). CNNs are artificial neural networks composed of a series of specific mathematical functions called hidden layers, sometimes called nodes and neurons, that transform raw input into a classification, identification, or prediction, and unlike other models, CNNs do not require manual extraction of features to make DDI predictions.

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