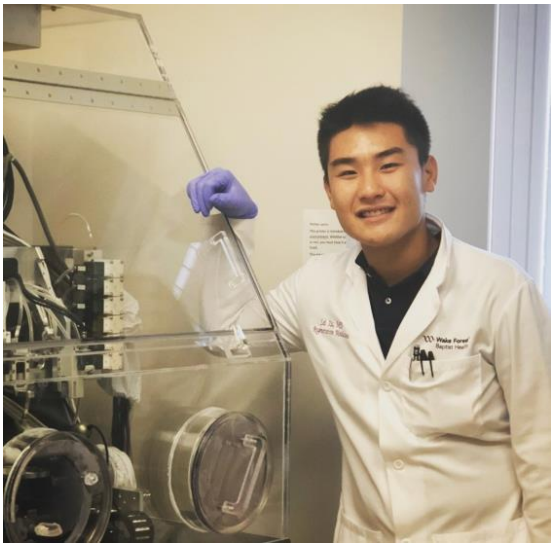
Wake Forest School of Medicine

Institute for Regenerative Medicine

WFIRM Summer Scholars Program 2018 – Scholar's Blog
Summer Scholars 2018 Profiles



Zishuai "Zack" Chou

University of California, Berkeley, Bioengineering

Faculty Advisor*: Anthony Atala, MD, Professor, Director of WFIRM*

I am a 3rd-year Chinese international student at UC Berkeley pursuing a degree in bioengineering, with an emphasis on biomaterials and tissue engineering. My interest in regenerative medicine was sparked by a high school summer program at Columbia University. I was deeply fascinated that stem cells could be directed into different fates through chemical and physical cues, which was like a dark magic to me. Since then, I have been immersing myself in various opportunities to uncover this "magic".

At UC Berkeley, I have been working in Dr. David Schaffer's Lab on creating a thermo-reversible hydrogel as for 3D culture applications. This allowed me to conduct a high-throughput screening of oligodendrocyte precursor cells' differentiation from pluripotent stem cells as well as generate neural organoid for human embryonic stem cells. In addition, I founded a project based bioprinting club, where we assembled and modified a 3D printer into an extrusion-based bioprinter. We also fabricated some hydrogels and characterized their mechanical and biological properties. Last summer, I incidentally attended WFIRM's Regenerative Medicine Essential course. It transformed my impression of regenerative medicine to a life-long pursuit. I had a dream to work at WFIRM as a summer scholar. Fortunately, it has come true.

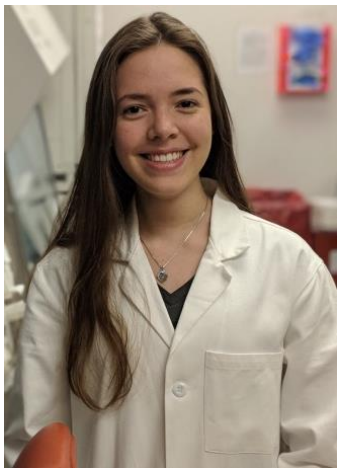
This summer, I will be working with Dr. Anthony Atala and Adam Jorgensen on evaluating the feasibility of human skin-derived hydrogel for skin bioprinting with multiple cell types. Human skin-derived hydrogel naturally contains ECM proteins and growth factors, which would enhance the growth of multiple types of skin cells, hence improving bioprinted skin grafts' mechanical properties. This is particularly significant for treating full thickness burns, where multiple types of skin cells are damaged and cannot be easily regenerated and for skin wound healing and dermal reconstruction. I will fabricate the hydrogel from decellularized human skin. Then I will evaluate the hydrogel's mechanical properties, biological properties and printability to determine its feasibility for skin bioprinting applications.

I have one year left at UC Berkeley. After completing the program at WFIRM, I plan to further develop my skills through working in biotech industries or research labs and then pursue an MD/ Ph.D. degree in bioengineering. I aspire to become a physician-engineer in regenerative medicine to translate current technologies into clinical therapies. The invaluable experience at WFIRM has definitely deepened my vision of regenerative medicine and sharpened my dream into more specific objectives. I'd like to thank everyone at WFIRM for creating such a memorable chapter in my life journey.

Bianca Cordazzo Vargas

Harvard College

Faculty Advisors: *Graça Almeida-Porada, MD, PhD, Professor and Christopher Porada, PhD, Associate Professor*



My name is Bianca Cordazzo and I am an international student from Ciudad del Este, Paraguay. I am a rising sophomore at Harvard College and even though I have to declare my concentration by the end of this year, Biomedical Engineering is currently one of my top options. Before coming to WFIRM, I had little experience doing research, and I considered the Summer Scholars Program at WFIRM to be a great opportunity to get more involved, improve my skills, and explore my different interests in science, which is a passion we all share.

My interest in STEM was initially sparked at the Paraguayan Mathematic Tournaments, in which I had the opportunity to participate as I grew up. This interest was strengthened with the different science classes I took during high school along with a chance to attend the 2014 Millennium Youth Camp, a science camp that took place in Helsinki, Finland. However, it wasn't until I started college that I was able to focus more in the life sciences with realization that I wanted to get involved in biomedical research. I am also passionate about astronomy and astrophysics, and a current challenge for me is trying to incorporate parts of these fields into my future research.

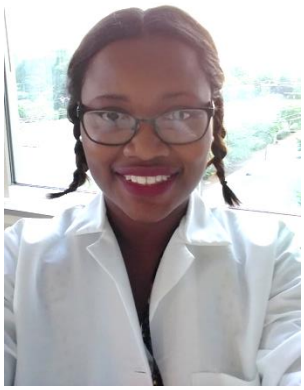
This summer I am working under the mentorship of Drs. Graça Almeida-Porada and Christopher Porada on a project to determine the effects of long-term exposure to microgravity and radiation outside low earth orbit (LEO), where future manned missions to Mars and near asteroids will take place. First, we are measuring the effects of microgravity on natural killer cells (NK cells), part of the innate immune system among whose many functions include tumor surveillance and protection against leukemogenesis. Concurrently, we are analyzing tissues from mice that were exposed to radiation analogous to that which astronauts would encounter in deep space. Since future space missions will be longer and outside the Earth's protection, it is of critical importance to understand the potential health risks present with these endeavors and determine how to approach these challenges accordingly.

In terms of future plans and goals, I am still deciding between pursuing a medical degree and attending graduate school. I am also interested in public health and education, which are fields I hope to get involved into in the years to come.

Olivia Cornett

Salem College, Chemistry

Faculty Advisor: *Hooman Sadri-Ardekani, MD, PhD, Assistant Professor*



My name is Olivia Cornett and I recently graduated from Salem College with a bachelor's degree in chemistry. I aspire to become a physician and I am in the process of applying to medical school. Before I was accepted into the WFIRM Program, I conducted my own undergraduate research project under the guidance of Dr. Douglas Linebarrier where we were experimenting with dietary compounds that might mimic the effects of acarbose (an important component in some diabetic drugs). I first heard about the WFIRM Summer Scholar program three years ago while conducting general research to learn more about the field of regenerative medicine. This spurred me to

pursue an opportunity to participate in the WFIRM summer scholars program with future goal to become a part of the exciting advances in enabling technologies supporting the field. I am very fortunate to have the opportunity to work in the Male Fertility Research Group this summer, with Dr. Hooman Sadri-Ardekani, MD-PhD and Dr. Nima P. Zarandi, MD.

The aim of the research project I will be working on, under the guidance of Dr. Sadri-Ardekani, is to develop a 3D human testis organoid system for Klinefelter patients using human XXY (Klinefelter) cells that have been isolated from the testicular tissues. Klinefelter patients are males that possess an additional copy of the X-chromosome, which leads to low testosterone levels and little to no sperm production. However, spermatogonial stem cells have been found in the testicular tissues of Klinefelter patients. These spermatogonial stem cells can differentiate into germ cells and somatic cells that are found in normal testicles. For this research project, spermatogonial stem cells that have been isolated and cultured in 2D (from cryopreservation) are being used to generate 3D testicular organoids which are analyzed over the course of three weeks for viability, maturation, the production of androgen and structure. Ideally, the 3D testicular organoids will produce testosterone for hyperandrogenism, and viable gametes that will address infertility.

After my internship at WFIRM, I plan to attend medical school during fall 2019. During my gap-year, I plan to gain more patient contact hours and work experience in the healthcare field. In my free time, I love to read, paint, journal and experience nature (with the exception of bugs).

Amit Cudykier

NC State University and University of North Carolina at Chapel Hill, Biomedical Engineering

Faculty Advisor: *Shay Soker, PhD, Professor*

I am a rising senior at NC State and UNC Joint Biomedical Engineering program with a concentration in instrumentation. I was born and raised in Israel and moved to the U.S three years ago to pursue my degree. Prior to my degree, I gained various experiences in the tech industry sector. I served in the military, during which time I worked on various material science projects. This was my first experience working in a professional technological environment. After my military service, I got a job at Intel where I held positions of Data Analyst and Manufacturing Specialist. During the first two years of college, I worked for an electronic medical record company as developer and analyst.

Solving software and manufacturing challenges was fulfilling, but all along I felt I want to work on problems with a potential to impact, change and save peoples lives. The biomedical field holds such opportunities! Understanding that every major biomedical innovation stems from scientific research, I knew it was crucial to gain such experience. Alongside the scientific research, it was important for me not to forget my industry roots and my will to provide valuable solutions to people. A friend told me about WFIRM and the summer scholars program. Following my own short research, I learned more about the amazing work that is being done here, work that is changing people lives. What attracted me the most was WFIRM's ability to conduct groundbreaking research while keeping an eye on clinical translation of the technology. I am proud to be part of such an organization and grateful for the opportunities and knowledge I will gain this summer.

This summer I will work under the mentorship of Dr. Shay Soker on a joint project with Dr. Nicole Levi-Polyachenko from Plastic Surgery. The goal of our project is to utilize a novel optical fiber imaging system and

micro-engineered tumors technology (tumor organoids) in order to study the therapeutic efficacy of photothermal nanoparticles. Using the imaging system, we will evaluate nanoparticle targeting and ablation capacity within the 3D colon cancer organoids in a real-time, nondestructive manner. The project aims to provide a more clinically relevant in vitro model of cancer and enable the development of novel and more precise and effective treatments.

After my graduation, I will pursue a position as an R&D Engineer in the biomedical industry. My goal is to be part of a team that develops new therapeutic technology that will profoundly impact people lives. My long-term goal is to be a founder of an innovative biomedical company.

Rawdah Elbahrawi
University of Alabama at Birmingham, Biomedical Engineering
Faculty Advisor: *Ji Hyun Kim, PhD, Instructor*

I am a rising junior studying Biomedical Engineering at the University of Alabama at Birmingham (UAB). I have been interested in the scientific and medical field since I can remember. When I was in elementary school, I wanted to be a pediatrician. In high school, I was given the opportunity to attend an International Baccalaureate program and it changed my perspective on how I can contribute to an ever-changing world. I learned that I wanted to be "hands on" in making a change. Furthermore, after attending the 5th Annual Regenerative Medicine course at WFIRM, I have become more certain that I am interested in a scientific or medical career. I have learned from the physicians and scientists I've met about changing tools, machines, and methods that are groundbreaking to the scientific and medical field.

This summer I am grateful to be working with Dr. Ji Hyun Kim and Dr. Ilho Park and their study on in situ muscle regeneration. Their main objectives are to develop an ECM scaffold using decellularized muscle fiber fragments, develop muscle fiber fragment scaffold by utilizing growth factors and chemotactic agent loaded forms and to validate this scaffold in a muscle defect animal model.

Two essential components to their study and my work is bioprinting and in situ regeneration. Bioprinting is crucial in that it allows us to mimic the complex architecture of the skeletal muscle tissue, so when used in vivo, its biological cues and functions cooperate with the natural flow of the body. The proteins examined with in situ regeneration in this study are SDF and IGF. SDF and IGF work hand-in-hand in stem cell recruitment and its differentiation. SDF recruits the stem cells through chemotaxis and IGF is responsible for the differentiation of these cells. Furthermore, for an in-situ regeneration process to be successful the recruitment of the host stem cell into the tissue or the tissue construct must be effective for the induction of the incoming cells into cell lineages to occur.

This summer I will be comparing the release kinetics of two different delivery methods of the proteins IGF and SDF. With the success of an effective delivery method, a constant transfer of biological cues and biological functions from the implanted scaffold would guide the host cells to form an integrated functional structure giving the skeletal muscle tissue the reminder that it has the capacity to regenerate, repair and ultimately heal. This work will be beneficial for cases such as volumetric muscle loss where the skeletal muscle is either destroyed or removed and with it its properties of repairing injuries. By introducing an effective delivery system, it will push the muscle to recall its natural regenerative powers.

After this summer at WFIRM, I will continue to pursue my undergraduate degree in Biomedical Engineering at UAB. I plan to immerse myself in clinical aspects of the medical field while continuing to be involved in research. I am unsure of the path I want to pursue postgraduation, however I do know it involves global health and medicine. I will be considering medical school, dental school, and PhD programs. In the meantime, I plan to become more involved in volunteering abroad. Although my career path is undecided, I am sure that my experiences here at WFIRM will guide my decision-making and future as a scientist. I am thankful for everyone at WFIRM for the opportunity, guidance, and knowledge.

Maryam Elizondo

Rice University, Bioengineering

Faculty Advisors: *James Yoo, PhD, Professor, Associate Director, CSO, and Sang Jin Lee, PhD, Associate Professor*

I am a rising senior at Rice University in Houston, Texas studying Bioengineering. I began doing research in Dr. Jordan Miller's lab during my sophomore year of college. The Miller lab specializes in 3D printing vasculature through various bioprinting modalities. I specifically worked on a project for central nervous system regeneration through the stereolithographic printing of a densely packed conduit channel geometry. Additionally, my favorite classes, Biomaterials and Tissue Engineering both taught by Dr. Tony Mikos introduced me to my current passion for biomaterials and their incorporation into medical devices and treatments for repair and regeneration. My work on this research with 3D printing and learning about tissue renewal through carefully chosen biomaterials sparked my passion for pursuing innovative and novel research having to do with regenerative medicine.

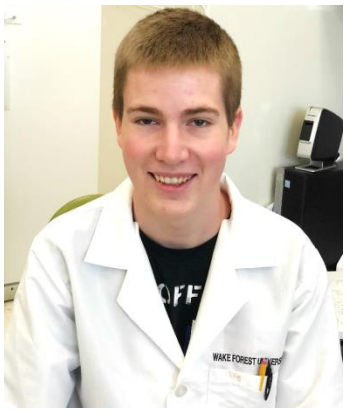
This summer I am excited to work with Drs. James Yoo and Sang Jin Lee on a biomaterials characterization project. I will study the rheological properties of 22 different bioink hydrogels for the purpose of extrusion-based 3D printing. This study will compile the rheological data that describes the bioink's viscosity, shear thinning properties, and "printability" into a database that will allow composite bioinks to be created with not only useful biocompatible properties, but also specially tailored rheological properties.

After completing the WFIRM Summer Scholar's Program, I hope to delve into my senior year at Rice University with a new understanding for regenerative medicine and new research skills. After my undergraduate career is over, I hope to pursue an MD/PhD program so that I can combine my passion for clinical medicine with a deep knowledge of the research process so that I can continue contributing to scientific world with new discoveries to help patients everywhere.

Grahame Evans

Duke University, Biology

Faculty Advisor: *Baisong Lu, PhD, Assistant Professor*



I am a rising senior at Duke University pursuing a B.S. in Biology. I am particularly interested in the intersection of 21st century scientific and technological endeavors, and I aspire to work in the biomedical research field. In fact, I first acquired this particular interest after seeing an ear being bioprinted in a WFIRM laboratory setting, now almost 8 years ago. My science-heavy course load at Duke has given me exposure to laboratory experiences in a variety of research projects as a part of

biology, chemistry, and genomics courses completed thus far. Notable coursework research experience includes isolating, cloning, sequencing, and analyzing transformed yeast genomic DNA for a molecular/genetic biology lab. This past semester, I conducted an independent research project analyzing the role of the ALT1-ALT2 paralogous gene pair in catabolism and biosynthesis pathways of *Saccharomyces cerevisiae* (yeast) in the laboratory of Fred Dietrich, PhD (Department of Molecular Genetics and Microbiology, Duke School of Medicine, Durham, NC).

Outside of my Duke Coursework, I have conducted and contributed to multiple original research endeavors examining emergent medical technologies through experiences such as independent summer research projects, laboratory experience in other summer internship programs, and past employment at Wake Forest School of Medicine. Last summer, I processed muscle tissue samples from Wistar rats and isolated sample protein solutions for Bradford and citrate synthase assays, gel electrophoresis, Western blot, and antibody analyses in the laboratory of Jane Reusch, MD, PhD (UC Denver Anschutz School of Medicine, Aurora, CO). Two summers ago, I conducted and published original research on the feasibility of emergent mobile electrocardiogram technology in screening for previously undiagnosed atrial fibrillation in African adult populations (AIC Kijabe Hospital, Kijabe, Kenya). I have also co-published an original quality-of-life analysis study examining the quantitative relationship(s) between subjective well-being and life expectancy with my previous boss and research mentor Elsayed Soliman, MD, MS (Wake Forest School of Medicine, Winston-Salem, NC).

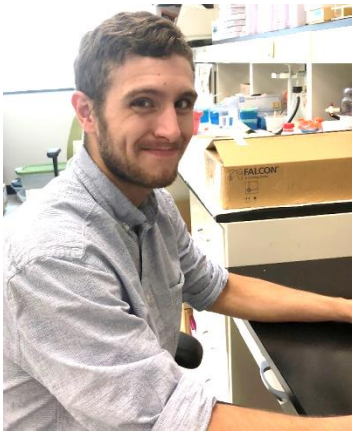
My primary WFIRM mentor is Baisong Lu, PhD, and the postdoctoral fellow under whom I will be working in the Lu lab is Vishruti Makani, PhD. This summer, my research will be focused on utilizing the CRISPR/Cas9 gene editing tool for Duchenne muscular dystrophy (DMD), the most severe form of muscular dystrophy stemming from genetic mutations in the dystrophin gene. Many such mutations in the dystrophin gene lead to reading frame disruption, ultimately resulting in the formation of truncated, non-functional dystrophin protein. One promising approach to restore dystrophin production is exon skipping. We will use a novel lentiviral-like particle system to deliver CRISPR/Cas9 to delete exon 51. I will analyze the efficacy of exon deletion by the aforementioned approach, utilizing muscle cells (a more relevant cell line) trans-differentiated from fibroblasts of human DMD patients. If successful across a variety of human muscle cell samples, this method stands to provide a great stride forward in DMD treatment research, as it allows for production of partially deleted, but functional dystrophin protein.

At the moment, I am interested in attending graduate school to pursue a PhD in some branch of biomedical science. Since I am especially interested in the real-life applications of technology and scientific intersections, I am also considering a career in biotech industry after receiving my PhD. Specific graduate programs that currently interest me include bioinformatics and computational biology/genomics.

Jake Gray

University of North Texas, Biology

Faculty Advisor: *John Jackson, PhD, Associate Professor*

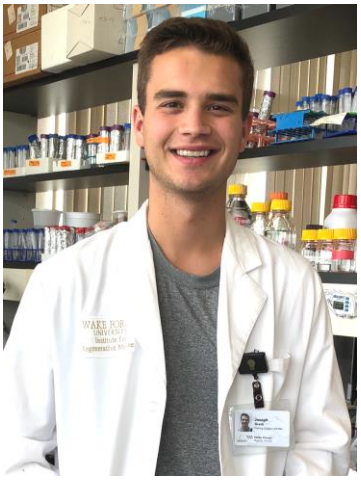


I am a senior at the University of North Texas majoring in biology. Prior to coming to WFIRM, I worked at the Center for Network Neuroscience, headed by Dr. Guenter Gross, on the UNT campus. There I managed the fabrication of multiple microelectrode arrays (MMEAs) which were either used in our lab to record the action potentials among networks of neurons, or sold to other research labs. This experience required a lot of troubleshooting on my part and led me to think about directing my career in a more bioengineering direction. This was when I discovered

the fields of tissue engineering and regenerative medicine, and subsequently the summer program here at WFIRM.

This summer I will be working in Dr. John Jackson's lab to investigate the use of small molecules in regenerative medicine. We will be studying the efficacy of several small molecules in their ability to ultimately regenerate hair cells within the inner ear. Our experiments will involve the use of a special cell line derived from mouse organ of corti in hopes that these molecules, which have already shown promise in mouse utricles, will one day be able to restore balance and hearing to patients whom have lost sensory cells within their inner ears.

With this experience not only will I gain valuable skills and knowledge, but a greater perspective on the many different directions in which I can take my career. After the completion of my bachelors, I plan to attend graduate school to get my master's degree in tissue engineering. From there I'll decide on a route that best suits my career goals. Working here at WFIRM for the summer is easily greatest opportunity I've ever received and I couldn't be more grateful for it.



Joseph Grech

Michigan State University, Human Biology

Faculty Advisors: *James Yoo, PhD, Professor, Associate Director, CSO, and Sang Jin Lee, PhD, Associate Professor*

Hi! My name is Joe Grech and I am a rising senior at Michigan State University (go Green!) studying Human Biology. My interest in scientific research began last summer while I completed a 12-week summer research program in Malawi, Africa, studying the prevalence of malaria causing *Plasmodium* parasite species. After returning to MSU in the fall, I joined a research lab studying tuberculosis pathogenesis.

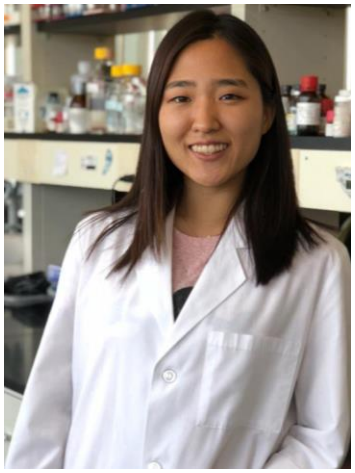
While I have thoroughly enjoyed the microbiology research I have participated in, I thought that this summer would be a great opportunity to research in a different field of study, particularly one that is more clinically applicable. That said, I was immediately intrigued when I came across WFIRM's Summer Scholars program, a research internship in regenerative medicine. I am extremely excited to be at WFIRM this summer, as I strongly believe that regenerative medicine is the future of medicine.

My summer research study will take part under Dr. James Yoo and Dr. Sang Jin Lee. The goal of my study is to optimize the printability and specificity of dECM hydrogel bioinks by comparing the dECM bioinks composed of the renal cortex, the renal medulla, and the whole kidney, respectively. Ultimately, results in this study could go a long way in one day producing 3D renal constructs that restore kidney function in vivo, replacing the need for dialysis and kidney allotransplantation.

Upon completion of the Summer Scholars program, I plan on returning to MSU in the fall for my final year of undergraduate study. I hope to one day obtain an MD and a Masters in Global Health to ultimately pursue a career in third-world medicine.

Boeun Hwang

University of Illinois at Urbana-Champaign, Bioengineering
Faculty Advisor: *Frank Marini, PhD, Professor*



My name is Boeun Hwang, and I am a rising senior at University of Illinois at Urbana-Champaign. I study bioengineering with a minor in materials science and engineering.

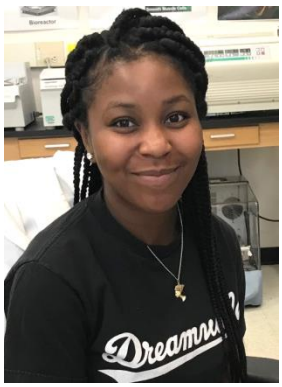
During the school year, I work in Dr. Andrew Smith's lab as an undergraduate researcher, focusing on microfluidics fabrication and single-cell level imaging using quantum dots. I have always found tissue engineering and regenerative medicine fascinating due to their translational nature. So last summer, I decided to set my foot in regenerative medicine by participating in stem cell research for newborn babies with heart defects. The experience convinced me to further pursue the field as I absolutely loved working on projects that can potentially change the lives of patients. This year, I wanted to not only perform impactful regenerative medicine, but also combine my engineering background with medicine. I found that WFIRM is the perfect place to do so as the institute hosts a wide range of interdisciplinary projects, from body-on-a-chip to 3D bioprinting.

At WFIRM, I work in Dr. Frank Marini's lab on comparison and optimization of optical tissue clearing techniques. Understanding the structure of tissues/organs is critical in studying their functions and mechanisms. Traditionally, thin slices of thick tissues had to be cut and imaged to visualize the cellular structure of the samples, which provides limited information. With recent advances in microscopy, imaging tissues at a greater depth has become feasible, yet still with difficulties. One of the contributing factors to this limited imaging depth is light scattering effect of thick tissues or organs, which makes them opaque in color. In order for a microscope to obtain an image, the light has to travel through the sample. However, light scattering components in tissues prevent the light from reaching the depth of interest. Therefore, by clearing the tissue samples light can travel further into the tissue, making 3D imaging of thick tissues possible. In this project, I will focus on comparing two tissue-clearing methods, inCITE, a technique developed by the Marini lab, and uDISCO, one of the most commonly used tissue clearing methods. At the end of the project, we aim to analyze the transparency, fluorescence signal intensity, and stainability of the whole mouse organs processed with the two methods and ultimately improve imaging process for regenerative medicine.

After my undergraduate education, I plan to pursue a PhD degree in biomedical engineering. I am confident this experience at WFIRM will expand my horizon in regenerative medicine and help me apply the knowledge in my future studies.

Rayia Johnson

Winston-Salem State University, Exercise Physiology
Faculty Advisor: *Tracy Criswell, PhD, Assistant Professor*



My name is Rayia Johnson and I am a rising senior at Winston-Salem State University where I am an Exercise Physiology (Exercise Science) major. During my collegiate experience, I have had a few experiences in a lab setting but nothing like the WFIRM lab. I have taken the basic courses of Biology, Chemistry and Anatomy and Physiology course labs. During these courses we learned basic principles such as pipetting, accurate measuring and lab safety. Every once in a while, we would conduct experiences with mild chemicals in non-formal setting.

My personal motivation for engaging in regenerative medicine is to explore my career options. I always wanted to see how labs conduct studies such as those I've read throughout many of my science classes. Regenerative medicine is advancing the field and new approaches in regenerative medicine science, methods and techniques. It is a place where scientists, engineers and clinicians come together with the ultimate goal to bring curative treatments and technologies to those who really need it. I have always wanted to help others and this is another way to do that and enhance tomorrow's medical field and science.

My project consists of observing the effects of PEMF (pulsed electromagnetic field) on growth and differentiation of C2C12 muscle cells. I will be working with Dr. Tracy Criswell. The purpose of this study is to find safe and effective ways to treat and care for military or civilian patients, who have severe muscle injury. Recent studies have demonstrated the ability of PEMF therapy shown to reduce inflammation, edema and pain. The goal of this project treat skeletal muscle stem cells (satellite cells) with PEMF in order to investigate whether this treatment can aid growth, differentiation and alignment of myofibers, which is necessary for function of tissue engineered muscle. We predict PEMF therapy will increase the efficiency of muscle cell therapy.

My future career goals consist of attending Occupational Therapy School. I want to eventually get my doctorate and open up my own practice or combine my services with several therapy practices. From my own family experiences, I have realized, especially in the context of autoimmune disorders, that an individual needs the attention of several doctors. I would like to make it easier for my family, myself and would be a great way to give back to others.

Victoria Kusztos
Tufts University, Biology
Faculty Advisor: *Stephen Walker, PhD, Associate Professor*

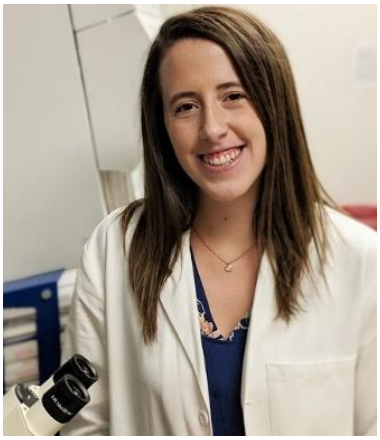
I am a rising senior at Tufts University majoring in Biology. My first research experience was the summer following my freshman year at the Jake Gittlen Laboratories for Cancer Research at the Pennsylvania State University College of Medicine. My project used mouse models to look for loss-of-function mutations in the adenomatous polyposis coli gene of mouse mammary tumors following Wnt1 independent relapse. During this experience, I was captivated by how the information I had learned in my Biology and Chemistry classes at Tufts translated into research. My interest in regenerative medicine was initially sparked by my experience in this lab as I observed how breast cancer research translated into practice. I was similarly drawn to the translational nature of regenerative medicine.

The following semester, I was motivated to become involved in research during the school year, which prompted me to join the Tufts Applied Cognition Laboratory. In this lab, I contributed to ongoing investigations using transcranial alternating current stimulation (tACS) to upregulate brain activity in regions of the brain that support task-switching and dual-tasking to observe effects on performance in these areas and examine the underlying cognitive architecture that supports these types of multitasking.

At WFIRM, I am excited to be working under the mentorship of Dr. Stephen Walker. My project will use immunofluorescent staining to compare the levels of CD3, CD4, and CD8 (markers for gut inflammation) in colonic tissue samples from children with autism and chronic gastrointestinal symptoms compared to samples

from typically developing children without gut inflammation. I will also be using molecular data to examine differential gene expression between these groups.

As for my future goals, I am currently in the process of applying to medical school and hope to matriculate in the fall of 2019. I would like to pursue a career that combines both the practice of medicine and basic science research.



Julie Leonard-Duke
Georgia Institute of Technology, Biomedical Engineering
Faculty Advisor: *Sean Murphy, PhD, Assistant Professor*

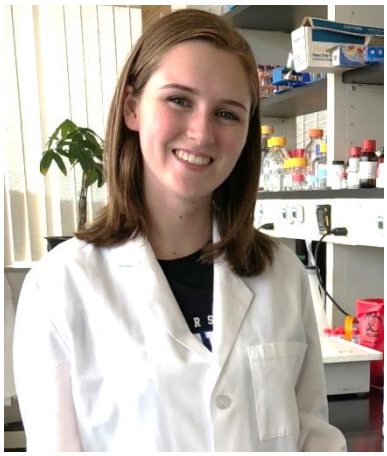
My interest in the medical field stems from my lifelong struggles with respiratory issues that have never been fully diagnosed. In high school, I began to explore the pulmonary field and the future of treatments in the field. Regenerative Medicine immediately attracted my interest, and knowing that I liked exploring to find the root cause of things, research seemed like a promising career path for me. My first formal research experience was in high school when I did a summer research internship at Tufts University in Bioinformatics. It affirmed my interest in the medical research field and ultimately led to me attending Georgia Institute of Technology to major in Biomedical Engineering. At Georgia Tech I aimed to get involved in research as quickly as possible to gain experience, and I was invited to join the Complex Rheology and Biomechanics Lab (CRAB Lab) at the end of my freshman year. During my time in the CRAB Lab I constructed a low cost EKG for zebrafish using a cell phone and a basic circuit board and developed a low cost EMG to measure cockroach neuro-muscular activity on different inclined surfaces. As I prepared to pass on the cockroach project to a team of researchers, I joined another lab focused on cardiovascular and lymphatic tissue mechanics under Dr. Rudolph Gleason. My experience in this lab was the first time I saw the impact medical research could have directly on the clinic. Our project aimed to understand the biomechanical properties of lymphatic vessels that can lead to lymphedema, a severe inflammation of the extremities in women that can occur after a mastectomy. I have devoted much of my time outside of classes to continuing to improve the quality of education at Georgia Tech. In the fall of 2016, I was chosen to represent the Georgia Tech biomedical engineering department as a University Innovation Fellow. As a Fellow, I have worked with other students and faculty to create a new introductory BME class that introduces freshman BME students to the field as well as to the process of Design Thinking. We successfully piloted this class in the fall of 2017. After great success it is set to become an official required part of the curriculum in fall 2019.

When looking for summer internships I wanted a program that could merge my interests of regenerative medicine and the pulmonary system while also giving me first hand lab experience. The WFIRM Summer Scholars program was recommended to me by a previous summer scholar who knew of the work happening at the Institute. I am excited to be working with Dr. Sean Murphy this summer whose expertise is in perinatal stem cells and the lungs. My project is to optimize how we grow human amnion epithelial cells (hAECs) so we can use them in cell therapies for inflammatory lung diseases such as cystic fibrosis and COPD. In previous studies, hAECs have demonstrated the immunomodulatory ability to suppress the severe inflammation seen in many of these diseases. These cells are found on the amnion layer of the placenta and can be isolated from donor placentas after delivery for therapeutic use. However, one donor does not result in enough cells for use in multiple treatments and hAECs are extremely difficult to grow in standard culture. We hypothesize that a technique called conditional reprogramming will cause these cells to live longer and proliferate to a greater extent. The second aim of our project is to evaluate how the immunomodulatory effects of these cells can be

enhanced through a process called priming. We hypothesize that priming will enhance the ability of hAECs to decrease lymphocyte proliferation and slow the progression of inflammatory diseases.

In the future, I hope to continue doing research in the regenerative medicine and pulmonary fields and attend graduate school. Ultimately, I would like to merge my interests of medical and educational research and be a professor at a research university where I can contribute in the lab and in the classroom.

Erin Maloney



University at Buffalo, Biomedical Engineering

Faculty Advisors: *Aleks Skardal, PhD, Assistant Professor, and Thomas Shupe, PhD, Assistant Professor*

I am a rising senior at the University at Buffalo majoring in Biomedical Engineering. I first became interested in regenerative medicine in the sixth grade during biology class when I came across the Vacanti mouse in my textbook. I thought it was amazing that first, scientists were able to make something in the shape of an ear and second, that they further grew the scaffold inside a mouse. I later found out that this field was called tissue engineering and it was always in the back of my mind throughout high school and through college.

My first experience with tissue engineering and regenerative medicine was in Dr. Yubing Xie's lab at SUNY Polytechnic Institute in Albany, NY. My project was to find a way to differentiate adipose-derived stem cells, or fat cells re-engineered into stem cells, into Schlemm's Canal cells, a cell type in the eye that drains the fluid that keeps the shape of the eye, as a model for high-throughput glaucoma drug testing. I designed and fabricated a fluidic device through 3D printing to help in the mechanical cues necessary for the process. My experience last summer was in Dr. Aram Chung's lab at Rensselaer Polytechnic Institute. My project was to optimize a microfluidic device for intracellular delivery of macromolecules, such as DNA, as a tool for other researchers to use. In essence, we wanted to break open the cellular membrane to deliver materials to the inside of cells through diffusion. During the school year, I worked in Dr. Stelios Andreadis' lab at the University at Buffalo learning different techniques and trying to understand how Cadherin-11, a protein to help cells bind together, affects cells *in vivo*.

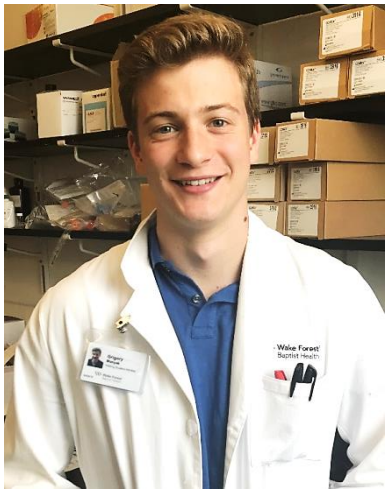
This summer, I am working with Drs. Aleksander Skardal and Thomas Shupe on bioprinting hydrogel-based organoid constructs in multi-well plates for increasing throughput of drug screening. The goal of the project is to be able to mass print organoids in a short amount of time for drug testing. This could be very helpful for things such as personalized medicine. For example, doctors could take a biopsy of a tumor and we could then take the cells from the sample and bioprint them into organoids. We could then run many different cocktails of chemotherapy to determine which cocktail will work best for the patient.

After completing my Bachelor's degree in Biomedical Engineering, I plan to pursue a PhD in Biomedical Engineering with a focus on bioprinting. This summer has shown me that bioprinting is what I am passionate about, and I hope to complete my PhD research here at WFIRM.

Grigory Manyak

Case Western Reserve University, Medical Anthropology, Pre-Medical

Faculty Advisor*: Anthony Atala, MD, Professor, Director of WFIRM*



My name is Grigory Manyak, and I am a rising sophomore from Los Angeles, California. I am studying Medical Anthropology at Case Western Reserve University, and plan to attend medical school after my undergraduate years. While at Case Western, I gained research experience during my freshman year by assisting research in a transgenic lab where I injected mice with hormones to initiate superovulation. Additionally, I worked in a physiology and biophysics lab studying hypertension in the thick ascending limbs of rat kidneys. Outside my work in the lab, I run charity volleyball tournaments on campus, and am a member of the varsity track and field team.

My interest in research began when I decided to pursue medicine, and connected the importance of research to that of the clinical setting in facilitating the betterment of patients' lives. WFIRM's Summer Scholar Program piqued my interest because it is one of the pioneers of the field of regenerative medicine, and was a place for me to learn about a wide variety of research topics as well as pursue my interests in the field. As an aspiring surgeon, I fully realize the importance of integrating regenerative research into the future of medicine, as such research will go on to change operating room procedures and ultimately medicine as a whole. Thus, when I was offered a summer internship, accepting was the obvious choice since I could explore my interests in an environment that would both encourage and facilitate my future success.

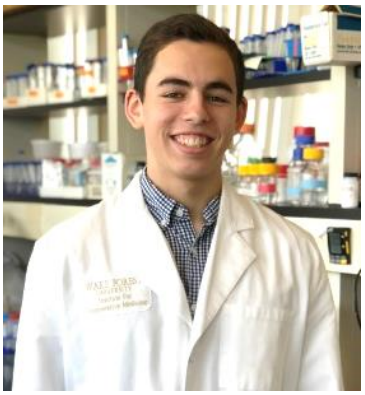
This summer, I am working under Dr. Anthony Atala and Dr. Jareer Kassis to study the Nrf2 antioxidant pathway and its mechanisms of action, as well as testing the efficacy of compounds designed to stimulate this pathway. Oxidative stress occurs when a cell has a disproportionately high amount of reactive oxygen species (ROS). This research is applicable to multiple types of disease, including fibrosis, cancer, and other neurodegenerative conditions. In doing my research I will investigating a variety of diseases and conditions such as liver cirrhosis and lung fibrosis in order to test both the mechanisms of action of the putative Nrf2-activating compounds as well as their efficacy in protecting cells from disease phenotypes.

This fall, I will return to Case Western to complete my undergraduate degree in Medical Anthropology and to continue my research in the labs on campus. Ultimately, I will be attending Case Western Reserve University for Medical School, as I have been admitted to a combined BA/MD program, and will pursue my dream of becoming a surgeon. My time here at WFIRM has further convinced me of the importance of research to the medical field; thus, I will also be considering pursuing research after attaining my MD. I would like to thank everyone at WFIRM for my experience this summer.

Robert Masi

Washington and Lee University, Biochemistry

Faculty Advisor: *Frank Marini, PhD, Professor*

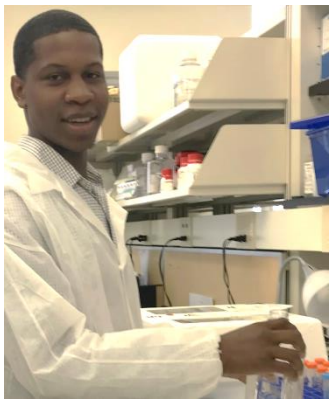


My name is Robert Masi and I'm a rising sophomore majoring in Biochemistry at Washington and Lee University in Lexington, VA. I first became interested in biomedical research in high school, when my older sister rehearsed her poster presentation for my family about a neuroscience project she worked on at her undergraduate institution. Before then, I had little idea that young people could

engage in such hands-on, independent problem solving of high level scientific topics. Once I began my undergraduate studies, I became enthralled by the research going on around me. During my first year, I was exposed to professors such as Dr. Kyle Friend and his research on RNA regulation during stem cell differentiation, on which I will work in the fall. I also learned about modern chemical and imaging techniques, but with a humanities application, in a research course on technical analysis of cultural heritage objects. These studies reinforced my interest in scientific exploration and drove me to seek a fusion between two seemingly disparate research areas. When I found the WFIRM Summer Scholars Program, I knew it would be the ideal place to combine my imaging experience with my emerging interest in regenerative medicine.

This summer, under the guidance of Dr. Frank Marini, Kristina Stumpf, and Lysette Mutkus, I am working to optimize a novel chemical technique to optically clear tissues for 3D imaging, and compare it to previously established methods. 3D imaging of regenerative tissues and organs is vital to ensuring that their biological and structural properties mirror those of the human body. Traditionally, light scattering and natural tissue translucency makes samples thicker than 2 mm difficult to image in three dimensions. Several chemical techniques have emerged to render tissue transparent by removing light-scattering components in a process known as tissue clearing. Our aim for the summer is to optimize an in-house tissue clearing technique and verify its compatibility with a range of fluorescent stains for enhanced tissue imaging. In the long term, this technique will facilitate whole-tissue imaging of regenerative structures and lead to deeper understanding of their compatibility with the human body.

Following the WFIRM summer scholars program, I am excited to engage in further study of the biochemical aspects of regenerative medicine and stem cell differentiation at Washington and Lee. I hope to apply my experience in regenerative medicine to my future career as a physician-scientist, where I will strive to bring the latest advancements in cell therapies and tissue regeneration directly to the bedside.



Christopher McCoy

Winston-Salem State University, Exercise Physiology

Faculty Advisor: *Young Min Ju, PhD, Instructor*

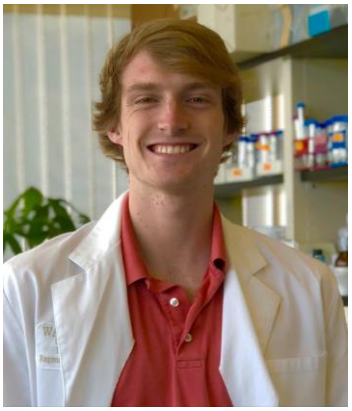
My name is Chris McCoy and I am a rising junior at Winston Salem State University where I am majoring in exercise physiology while minoring in public health. I am also a research scholar for the R.I.S.E program at Winston Salem State University where I engage in biomedical research. I became interested in regenerative medicine a while back when I first heard of 3D bioprinting. I thought that the approach of using 3D bioprinting to create organs and tissues using was so very innovative, interesting and cool and I wanted to experience and witness this for myself so I became interested in regenerative medicine as well as other biomedical research. To be here at WFIRM where they perform this procedure along with many other great studies is an amazing feat, and I would like to thank WFIRM for the opportunity.

Here at WFIRM I am working on the project of Targeted Angiogenesis using a drug-eluting scaffold under the mentorship of Dr. Young Min Ju. Angiogenesis is the physiological process through which new blood vessels form from pre-existing vessels. The challenge is for cell-based implants for large-scale engineered tissue that have an insufficient supply of oxygen and other nutrients. This supply is critical to the survival of host and implanted cells. We will be looking into how to control these vascular networks for tissue engineering applications. After graduating with a degree in exercise science, I plan to attend a physical or occupational therapy graduate program. While doing so I plan to continue doing research in regenerative medicine or some other biomedical research.

Sean Muir

Wake Forest University, Medicinal Chemistry

Faculty Advisors: *Khalil Bitar, PhD, Professor and*
Giuseppe Orlando, MD, PhD, Marie Curie Fellow and Assistant Professor



I consider Regenerative Medicine to be "the new era in medicine". Currently researchers all around the world are investigating stem cells and other biological regenerative mechanisms as therapies for various pathological conditions. Since the very first days of my studies I have been focusing my efforts on becoming a medical doctor. My interest in Regenerative Medicine is combined with my love of sports focusing my interests on Regenerative Medicine as applied in Sports Medicine and Orthopedic Surgery. As Regenerative Medicine is beginning to offer curative treatments for osteoarthritis, tendinitis, and partial meniscal tears, serving as an "early adopter" specialty for commercial applications of these novel technologies, I find this experience at the WFIRM to fit perfectly in my career.

My Wake Forest University undergraduate education is providing me with the opportunities to fulfill my goal of becoming a medical doctor by empowering me with the tools needed to become knowledgeable in research. During the summer of my freshman year, I participated in a research project at The Ohio State University in a Comparative Orthobiologics Research Laboratory. This laboratory experienced was combined with a working experience at the Ohio State Sports Medicine Clinic, investigating different orthobiologic treatments. Later, during my sophomore year, I participated in a genetics research project identifying duplication of gene PAINless in mutant *Drosophilia Melanogaster*. I was honored when I heard I would be joining WFIRM as a Summer Scholar under the mentorship of Drs. Khalil Bitar and Giuseppe Orlando and their teams. During my time at WFIRM, I will be focusing my efforts in investigating current methods for the production of renal extracellular matrix (ECM). I will learn basic decellularization techniques and biomaterial properties in order to maximize the regenerative properties of the ECM. The aim of the project is to obtain an acellular renal scaffold that can be the substrate of an ECM-based hydrogel for cellular application. Eventually the renal ECM-hydrogel will be tuned and optimized in order to support cell growth and expansion. The long-term goal will be to investigate different methods for ECM-based hydrogel production according to different applications in Regenerative Medicine such artificial organ bioengineering and drug testing.

I am currently pursuing a Bachelor of Science in general chemistry focusing on medicinal chemistry and believe that it has strongly supported my interests in regenerative medicine. I am confident that my determination for becoming a medical doctor and experiences in state of the art research programs will provide me with the opportunity to become an orthopedic surgeon and a surgeon-scientist.

Agne Nixon

Washington State University, Biological Sciences

Faculty Advisor: *John Jackson, PhD, Associate Professor*

My name is Agne Nixon and I am a post-baccalaureate student at Washington State University, Tri Cities. Prior to beginning my foray into biology, I earned my law degree at Vilnius University in my home country of Lithuania. I moved to the United States in 2015 with the plan to continue my work in the legal field. After much personal reflection, I began to understand I was far more interested in the elegance of science and particularly the intricacies of biology. This epiphany propelled me to return to

school to begin earning pre-requisites for further graduate studies in health care.

While in school, I began to explore opportunities to get involved outside of the classroom and was fortunate enough to be taken on by my anatomy professor as a research assistant in his lab. Currently, I am working under the tutelage of Dr. Cooper to study the evolutionary development of fish with an emphasis on cranial biomechanics, skull morphology, and feeding strategies. We hope to better understand whether certain genetic modifications cause significantly different alterations of cranial morphogenesis. My interest in regenerative medicine has been fueled by my initial exposure to the regenerative properties of zebrafish that I have seen in my research at Washington State Universty. The opportunity to expand on my knowledge base and learn more about this field is what brought me to WFIRM this summer.

As a summer scholar, I am excited to be part of the team under the guidance of Drs. Jackson, Sivanandane and Sequeira working on bioengineering ovarian follicles. Specifically, our goal is to develop ovarian follicles that lead to egg production. Infertility due to a variety of etiologies is a substantial concern for many women. We will be working with differentiated stem cells, in particular, oogonia, granulosa, and theca cells to develop a follicle that is most similar in structure and function to live human tissue. This will be done via the use of biomaterials to provide an environment and scaffold through which these organoids will develop. Such a process requires the stepwise aggregation of cell types as the follicle forms and prevention of cell migration, which is the focus of my work at WFIRM this summer.

This academic year I will finish my pre-requisites for medical school and apply with the aspiration to matriculate in fall of 2019. My goal is to continue with academic research while being involved in the hands-on delivery of health care in a way that will improve patient outcomes, particularly with regard to preventable illnesses. I am certain that I will carry this experience at WFIRM with me as I pursue this dream and I am thankful for this incredible learning opportunity.

Andrew Rabah

University of Michigan, Cell and Molecular Biology

Faculty Advisors: *Graça Almeida-Porada, MD, PhD, Professor and Christopher Porada, PhD, Associate Professor*

My name is Andrew Rabah and I am a rising senior at the University of Michigan studying Cell and Molecular Biology with a concentration in Biomedical Engineering. At the University of Michigan, I gained experience working in an intracellular protein signaling lab, studying various cellular stress responses. Through my coursework and previous research experiences, I have gained an interest in pursuing a career in academic research. As we expand our knowledge on how cellular niches can impact the regenerative capacity of our body, our understanding of the clinical potential regenerative medicine holds has also expanded. For this reason, I have developed a deep interest in the field of regenerative tissue therapy, with the hopes of improving patient care around the world. This same motive is what sparked my interest in the Summer Scholars Program at WFIRM. This summer, I am working in the Porada Lab under the mentorship of Drs. Graça Almeida-Porada and Christopher Porada, investigating a cell and gene-based therapy for the treatment of Hemophilia A (HA). Hemophilia A is an X-linked congenital bleeding disorder that affects 1 in 5000 males born. It is a monogenic disease caused by a mutation in the FVIII gene, which leads to a defective, or absence of, FVIII protein. Patients with the severe phenotype have less than 1% of normal factor VIII activity, and can have spontaneous hemarthrosis, hematomas, internal bleeding, and prolonged bleeding episodes. Current treatment for Hemophilia A consists of protein replacement therapy with

recombinant FVIII. However, 75% of people with Hemophilia A do not have access to this treatment, and 30% of people who receive prophylactic treatment develop inhibitory antibodies which can render the treatment ineffective, putting these patients at a tremendous risk. In the Porada Lab, we are developing a cell and gene delivery approach to treat patients prior to birth. Although we expect this approach to be curative, the delivery of FVIII during gestation will induce tolerance to the protein, so if the patients still need treatment after birth, they will not develop inhibitory antibodies. I hope my work during this summer will contribute to developing a novel therapy or even a cure for patients with Hemophilia A.

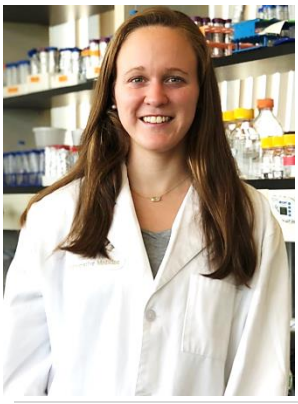
After my senior year, I will be attending graduate school at the University of Michigan earning a Master's degree in Biomedical Engineering. After that, I plan on attending medical school, so I can help bring new therapies to patients through both clinical and preclinical research.

Nancy Rutishauser

Fordham College at Rose Hill, Biological Sciences
Faculty Advisor: *Emmanuel Opara, PhD, Professor*

I am a rising senior at Fordham College at Rose Hill majoring in Biological Sciences and minoring in Spanish. Last summer, I conducted urban ecology field research investigating the impact of invasive turtle species in Brooklyn green spaces through a joint program between the Wildlife Conservation Society and Fordham University. This past year, I began working in Dr. Silvia Finnemann's lab at Fordham University investigating the cytoskeleton of the retinal pigment epithelium in relation to its phagocytic activity. I plan to complete my senior thesis this coming year in Dr. Finnemann's lab. While I have had some limited research experience, I had never been exposed to the field of regenerative medicine or such a large, collaborative laboratory facility until coming to WFIRM.

This summer I have the privilege of working under mentorship of Dr. Emmanuel Opara at WFIRM. Dr. Opara's lab works on the encapsulation of islet cells in alginate as a potential treatment for Type I Diabetes. One roadblock to clinical translation is ensuring the islet cells have an adequate supply of oxygen in the time it takes for the body's vasculature to grow and reach the implanted cells. My project aims to improve upon the current approach to oxygen generation used in the lab through development of an oxygen-releasing antioxidant polymeric scaffold. After graduating next spring, I plan on pursuing an MD and ultimately hope to specialize in pediatric surgery. The WFIRM Summer Scholars Program has exposed me to the novel approaches being investigated in the field of regenerative medicine, and I hope to be involved in the clinical translation of such research in my future career.



Kate Singletary

Davidson College, Psychology
Faculty Advisor: *Vijay Gorantla, MD, PhD, Associate Professor*
Secondary Faculty Advisors: *Frank Marini, PhD, Professor, and Fatih Zor, MD*

My name is Kate Singletary and I am a rising senior and psychology major at Davidson College, where I am also on the field hockey team. I have been interested in medicine in any capacity since I was a child. I live in Winston-Salem, so I began to volunteer at Wake Forest Baptist Medical Center in high school and was able to start gaining valuable experience interacting with patients and their families. I have also been able to shadow

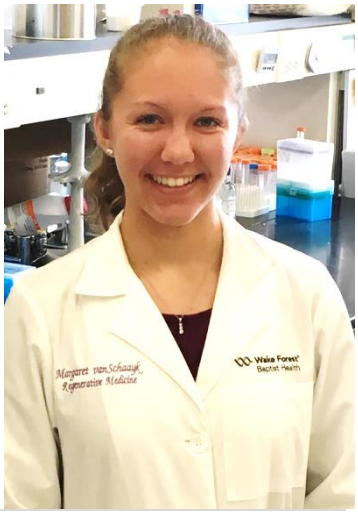
multiple surgeons here and elsewhere, and I have loved every moment of it. Based on my clinical shadowing experiences, I wanted to also be able to gain experience on the researcher's side to see the process of creating the products and treatments that are ultimately affecting patients. I toured WFIRM in middle school on a class field trip, and I was absolutely amazed by the idea of regenerative medicine; remembering this experience, I knew I wanted to learn about the field and to do research at WFIRM because of the invaluable experiences I knew I would be able to gain at such an innovative institution.

This summer I am working under the mentorship of Drs. Vijay Gorantla and Faith Zor to learn about the allotransplantation of composite tissue in rats, such as limbs and flaps. Composite tissues are grafts that contain multiple tissue types, such as a limb containing muscle, bone, nerve, and blood vessels. These allografted limbs can be used to provide suitable grafts to someone who has lost portions of limb due to disease or trauma. As a way to assess the effectiveness and suitability of the allograft, we will be employing a novel tissue clearing technique, which causes the donor graft to become see through for three-dimensional optical imaging. For this portion of the project, I am also working with Dr. Frank Marini as my co-mentor to learn about his techniques for optical tissue clearing. My project will involve applying Dr. Marini's tissue clearing techniques called inCITE (index matched clear imaging for tissue evaluation) to the composite tissue obtained through the surgical techniques of Dr. Gorantla and Dr. Zor. Tissue clearing is a method of treating tissues with chemistries that remove light scattering molecules and renders them transparent so that they can be imaged and biologically examined. Dr. Marini has developed tissue clearing techniques that have been applied to a variety of tissue types, but such clearing techniques have not yet been applied to composite tissue. Because of the natural translucency of tissues, previous methods used to clear tissue in order to examine and image them have involved slicing or immersing in potentially destructive solvents, which damage the tissue. The goal of my project is to be able to develop a technique that allows for the clearing of composite tissue so that more complex structures such as limbs can be cleared, and therefore examined and imaged, while preserving the 3D structure and condition of the sample.

After graduating from Davidson in the spring of 2019, I plan to attend PA school or medical school as the next step in my education. Although I am not yet sure of which specific career path I will be taking, I love the hospital environment and I will continue to work toward my goal of entering the medical field in whichever career I end up choosing. The research experience I am gaining at WFIRM will surely influence which specific direction I will go and what research I may do in the future. I am so incredibly thankful for the opportunity everyone at WFIRM is giving me through such valuable experiences of working in the lab and being a part of such innovative research.

Nicole VanOstrand

Rochester Institute of Technology, Biomedical Engineering
Faculty Advisor*: Anthony Atala, MD, Professor, Director of WFIRM*

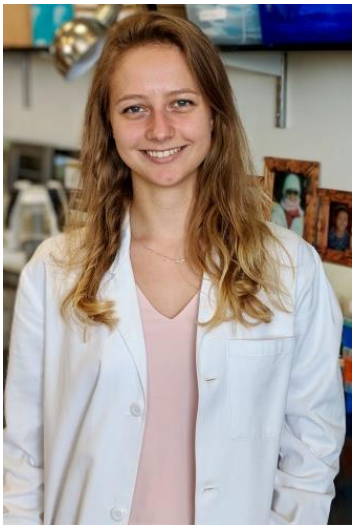


I am a rising third year biomedical engineering student at Rochester Institute of Technology (RIT). At RIT, I worked in a NanoBio Device Laboratory on a project geared towards the development of an inexpensive and high-throughput screening scheme for stem cell differentiation and drug toxicity. My interest in cancer impelled me to initiate a project involving the migration of four different cancer cell types: T24, 5637, MDA-MB-231, and MCF7. I performed preliminary experiments to assess the velocity and path of cell migration in 24 hours at normal culture conditions. When I return to RIT after this summer at WFIRM, I will be continuing my cancer cell migration project and I hope to be able to observe how co-culturing the different cancer cells together effect their migration and proliferation.

I have always had an interest in math and science since I was young, but I also became very interested in the medical field when my grandfather went into kidney failure and then eventually passed away due to heart problems. I did not want people to have to die waiting for transplants anymore and that is when I discovered the fields of regenerative medicine and tissue engineering. I decided to apply my love for math and science and my interest in the medical field into a biomedical engineering degree.

At WFIRM, I am working under the primary mentorship of Dr. Anthony Atala and Goodwell Nzou, PhD candidate to understand the effect of hypoxia on the blood brain barrier. I will be taking a previously developed 3D spheroid model of the brain with its functional blood brain barrier and will introduce hypoxic conditions so that it will model what happens to the brain when someone experiences a stroke. My goal for the summer is to identify the effect of hypoxia on the basement membrane of the blood brain barrier, assess neuronal degeneration after inducing hypoxia on the model, and evaluate the effect of blood brain barrier protective and anti-inflammatory agents to see if the effects of hypoxia on the brain can be reversed.

My future plans include going to graduate school to obtain a degree that will help me along my path to do ongoing research in the fields of regenerative medicine and tissue engineering.



Ugne Ziausyte

Carnegie Mellon University, Biological Sciences

Faculty Advisor: *Colin Bishop, PhD, Professor*

My undergraduate career has been marked by varied experiences. As a Biological Sciences major at Carnegie Mellon University, I have a strong belief in interdisciplinary work and the importance of understanding many aspects of the field. Therefore, my first research experience was with Dr. Jonathan Minden at Carnegie Mellon, who is known for the wide array of projects in his lab. There, I am working on a project involving analyzing protein changes in Drosophila Melanogaster and Drosophila Simulans due to Wolbachia infection, in an effort to better understand their strange behavioral changes. By understanding the mechanism behind these changes, we can learn more about how Wolbachia manipulates the host and how that influences its ability to outcompete deadly viruses such as ZIKA. Ultimately, a foundational understanding of Wolbachia will provide information as to how we might be able to harness Wolbachia's natural competitive edge to treat deadly disease.

In the interest of expanding my horizons into other areas of research, I applied to the WFIRM Summer Scholars program. I was particularly excited about the prospect of working with cells and tissues to develop novel ways to cure disease. For me, if I feel like the work I am doing has the potential to help people, I am more passionate about doing it. This is what attracts me to the field of regenerative medicine. This summer, I am working with Dr. Colin Bishop using liver organoids as a model for liver fibrosis. Currently, there is no drug that can be used to reverse liver fibrosis. Generally, treatment for liver fibrosis is liver transplant, which is expensive and difficult. We are testing a drug that we hope will reverse liver fibrosis without the need for surgery. Although this drug has already been tested in 2D cell lines, my project focuses on testing the drug's efficacy in 3D liver organoids. This is important, because organoids are a closer approximation to a human liver than cell lines and will give rise to more representative data. To do this, we will induce liver fibrosis in the organoids, and then administer the drug and see how well it reduced the fibrosis. Additionally, we will be determining the half-life of the drug,

checking its toxicity, and looking at the gene expression in the organoid in response to the drug. Ultimately, we hope to expand the project into looking at heart and lung fibrosis as well. Although I will not be present to experience the full scope of the project, I am grateful for the opportunity to help move the project forward and learn about what it really means to do research in a cutting-edge field.

In the immediate future, I will be continuing research at Carnegie Mellon. During the remainder of my time there, I hope to get more experience shadowing physicians and doing research, in the hopes of pursuing an MD/PhD in graduate school. By becoming a physician scientist, I will work to further the critical research that helps everyone live better lives. My experience at WFIRM has only reaffirmed my commitment to research.